OPERATIVE SURGERY.

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OPERATIVE SURGERY.

Catholic University School of Medicine.

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THE object of this Note-book is to place before the Student at least one reliable method of carrying out each important operation, leaving space for notes and personal observations made during the carrying out of such procedures, and also for such remarks as are accentuated by the Professor. The plates are copies from the best works on the subject, and the photographs and drawings have been specially prepared for this Remembrancer. The letterpress contains descriptions of the different operations by the leading teachers of operative surgery.

CATHOLIC UNIVERSITY NOTE-BOOK

OF

OPERATIVE SURGERY.

LIGATURES AND SUTURES.

Ligatures may be of catgut, kangaroo tendon, silk, tape, or elastic tubing—the latter two as temporary aids.

Catgut may be prepared by placing for 1 hour in 1–1000 corrosive sublimate solution, then for eight days in oil of juniper wood. After this it may be kept in rectified spirit containing one part in ten of oil of juniper.

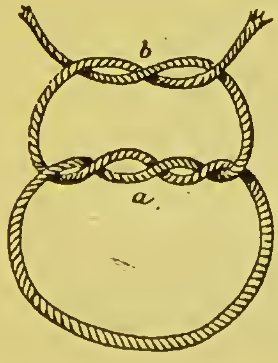
Or, boil in alcohol in Jellett's metal steriliser.

Silk, which is the best ligature material, may be rendered aseptic thus:—

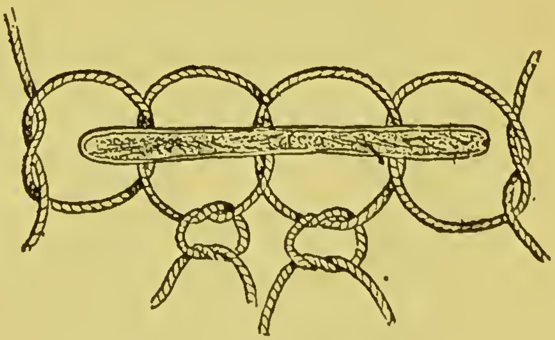
a. Boil in 1–500 corrosive sublimate for 30 minutes, and preserve in fresh corsosive sublimate solution of same strength.

b. Arrange it in loose skeins, boil in 5 per cent. carbolic solution, wind on glass reels, and immerse in fresh 5 per cent. carbolic solution, which is to be changed every week.

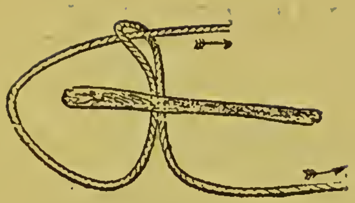
Before starting the application of ligatures it is well that we should be acquainted with the various knots used in surgery; the most important are here depicted.



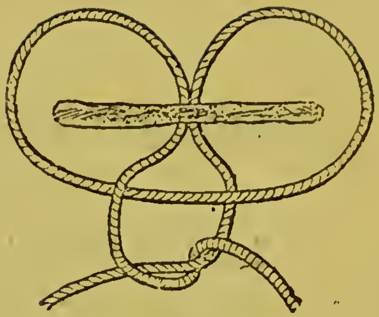
Surgeons'.



Wallichk's Continuous Ligature.



Bantock's.



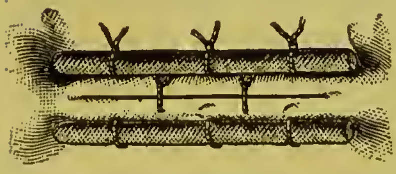
Tait's (Staffordshire).

SUTURES.

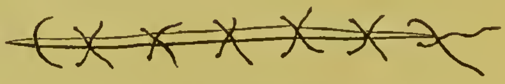
As well as silk and catgut prepared as above, silver wire and silk-worm gut may be used for sutures. They are best rendered aseptic by heating to 250° F. in a steriliser and then preserving in rectified spirit, or by boiling.

Amongst the various methods of applying sutures the following are worthy of note:—

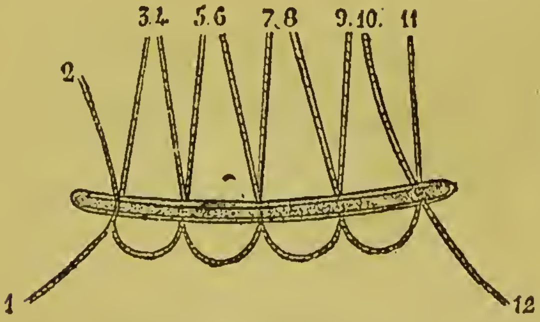
GENERAL.



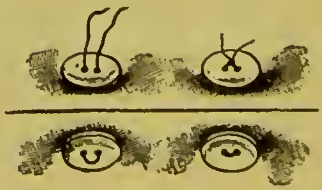
Quilled.



Herringbone.

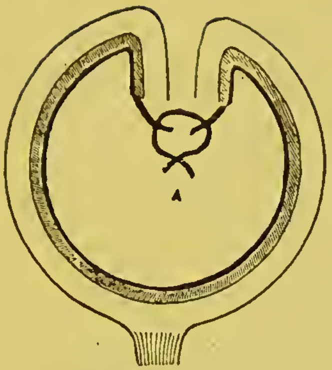


Chain Suture (Long's).

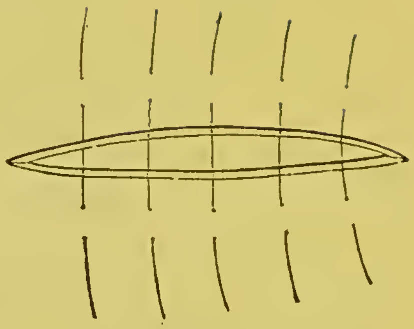


Button.

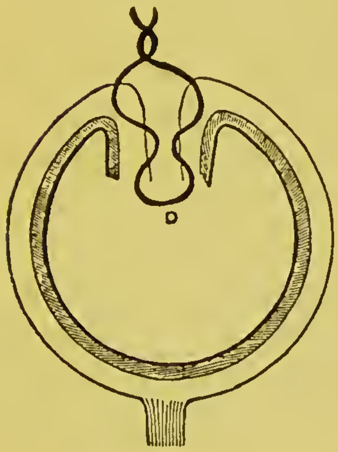
INTESTINAL.



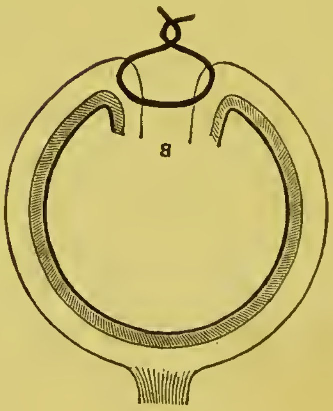
Czerny.



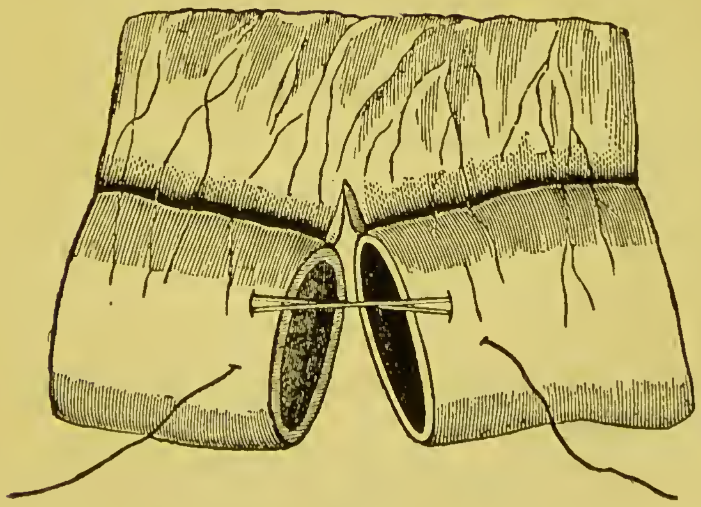
Lembert.



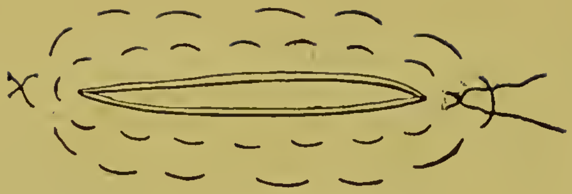
Gussenbaur.



Lembert.



Gély



Braman's Purse-string.

DRAINAGE.

Drainage may be carried out by means of glass, bone, or rubber tubes, or by stout silk or strips of iodoform gauze. These latter must be used only for temporary drainage, as they readily become infected. Where applicable the glass tube is the most perfect. Glass tubes are sterilised by boiling and they may then be kept in corrosive sublimate solution. Bone tubes are kept in carbolised oil, but they cannot be relied upon.

To prepare rubber drains or ligatures, place them for five days in water kept at 95° F. in a culture oven; renew the water daily. Then immerse in corrosive sublimate solution, 1–1000, or carbolic solution 5 per cent. Change the same every second day for a fortnight. Preserve in sublimate or carbolic solution.

LIGATURE OF VESSELS.

The steps of this procedure are:—

1st. Straight incision down to the sheath.

2nd. Pick up the sheath, raise it free from the artery, and open as in Fig. 1.

3rd. Still holding the sheath with forceps, pass aneurism needle empty at right angles to the line of the artery.

4th. Thread the needle and withdraw without traction by a circular motion round the vessel.

5th. Tie down *against the artery, not by pulling threads towards you.*

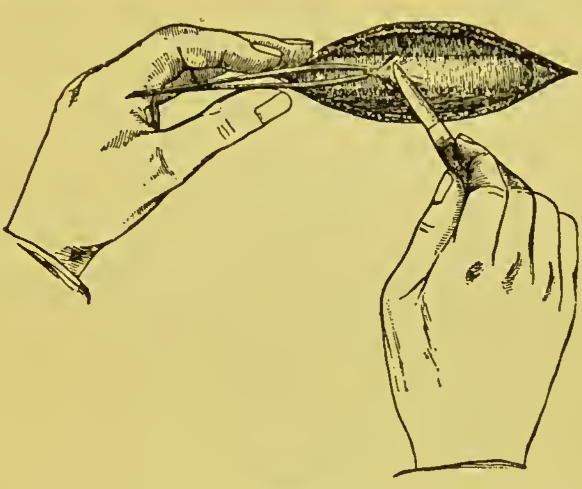
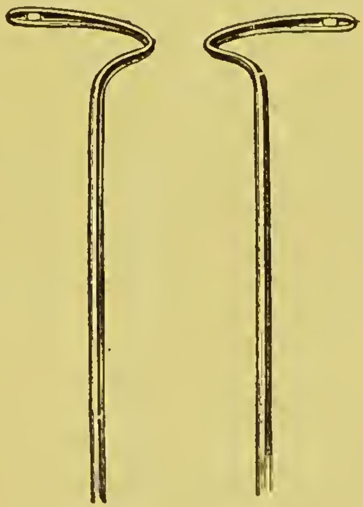


Fig. 1.

It is well to be provided with aneurism needles, such as are here depicted, so that vessels in awkward situations may be secured without much disturbance of their sheath. The separation of the sheath for any distance interferes with the blood supply of the arterial wall, and may lead to secondary hæmorrhage.



Aneurism Needles.

The chief points to be noted in reference to ligature of vessels are :—

1st. The exact line of the artery.
2nd. Its depth from the surface.
3rd. The important structures to be avoided in cutting down upon or securing it.

It is essential to keep your attention fixed on the guides and not bother about the vessel until you reach the sheath.

In the following brief notes I have determined on giving only the guide, the position and length of incision, and the structures to be avoided. The general relational anatomy I leave to be inserted by the student.

LIGATURE OF ARTERIES.

Palmar Arch (Superficial) :—

Guide : A line midway between the central palmar fold and the border of the thenar eminence when thumb is abducted.

Incision : Transverse 1¼ inch, beginning at hypothenar eminence.

Avoid cutting too deeply, or the tendons may be injured.

Palmar Arch (Deep) :—

Direct ligature is not advisable, nor is ligature of radial and ulnar; if hæmorrhage persists from interosseous or abnormal median, ligature of brachial at bend of elbow is indicated.

RADIAL.

The course of the radial is marked by a line drawn from the centre of the elbow to the inner side of the styloid process of the radius, where the vessel winds backwards under the extensors of thumb.

At back of wrist :—

Guide : Tendons of extensor-primi and secundi internodii pollicis.

Incision : On line with and between these tendons, 1 inch long.

Avoid : Vein which is superficial to artery and separated from it by deep fascia.

b. Lower Third :—

Guide : Outer border of tendon of flexor carpi radialis.

Incision : Two inches long, not going farther downwards than base of styloid process of radius. Fig. 2, A.

Avoid : Superficial radial vein, include venæ-comites in ligature rather than tear them, should separation be difficult.

c. Middle Third :—

Guide : Line from middle of bend of elbow to base of radial styloid process.

Incision : Two inches long in middle of this line. Fig. 2, A.

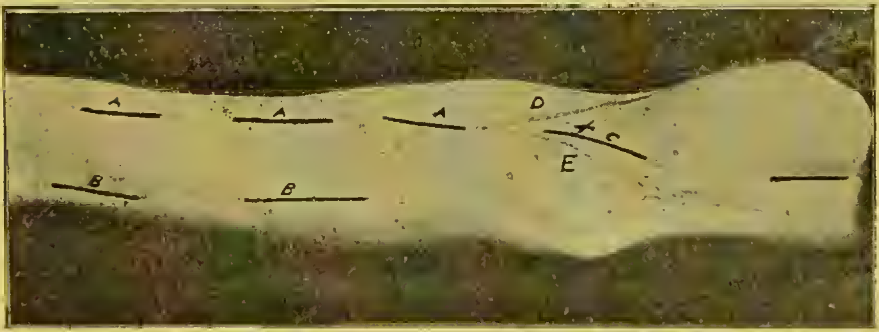


Fig. 2.

Avoid : Radial nerve and anterior division of musculo-cutaneous. Also avoid passing external to supinator longus tendon—the artery lies on its ulnar side.

d. Upper Third :—

Guide : "Superficial" line mentioned above. "Deep fibres of pronator teres running obliquely down and out. Supinator fibres vertical.

Incision : Two and a half inches in length, commencing 1 inch below bend of elbow. Fig. 2.

Avoid : Radial nerve if exposed, lying on outer side.

ULNAR.

Guide : The course of this vessel is marked by a line drawn from the front of the internal tuberosity of the humerus to the outer side of the pisiform bone.

Lower Third :—

Guide : The outer border of the flexor carpi ulnaris and the pisiform bone.

Incision : Two inches long, not extending beyond pisiform. Fig. 2, B.

Avoid : Ulnar nerve behind and internal to artery.

Middle Third :—

Guide : The superficial guide is the line mentioned above. The deep one is the white line which indicates the gap between the flexor carpi ulnaris and the flexor sublimis digitorum.

Incision : Two and a half inches in line of artery. Fig. 2, B.

Avoid : Ulnar nerve which is internal, and slightly superficial.

BRACHIAL.

The course of this vessel is marked by a line from the junction of the middle and anterior thirds of the outlet of the axilla to the middle of the bend of elbow.

At bend of elbow :—

Guide : The inner edge of biceps tendon.

Incision: Two and a half inches, oblique downwards and outwards, so that centre corresponds to the fold of elbow. Fig. 2, C.

Avoid: Median basilic vein (E, Fig. 2) superficially and the median nerve deeply, and on inner side.

Middle Third:—

Guide: Inner edge of biceps muscle.

Incision: Two and a half inches in line of artery. Fig. 3.

Avoid: Basilic vein which is superficial and internal, median nerve which is in front, and ulnar nerve to the inner side.

Ligature in Upper Third:—

Guide: Edge of coraco-brachialis.

Incision: Three inches in length along guide line from lower border of axilla.

Avoid: Basilic vein in front and median nerve outside, ulnar and internal cutaneous nerves within.

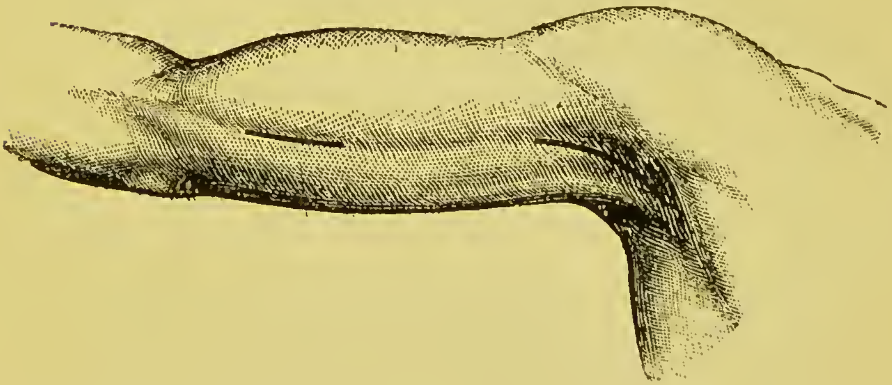


Fig. 3.

AXILLARY.

Place the arm at right angles to the body, then draw a line from the middle of the clavicle to the inner edge of the coraco-brachialis.

Lower Third :—

Guide : Inner edge of coraco-brachialis.

Incision : Three inches in length ; downwards from junction of the middle and anterior third of outlet of axilla. Fig. 3.

Avoid : Median and musculo-cutaneous nerves, drawing them outwards, internal cutaneous nerve which is drawn inwards, and the venæ-comites. Plate I.

Upper Third :—

Guide : "Superficial" lower edge of clavicle, "deep" cephalic vein.

Incision : Convex downwards from coracoid process to inner end of clavicle. Plate II.

Avoid : Cephalic vein in front, axillary vein below and internal, and brachial plexus outside and above.

SUBCLAVIAN.

Line from sterno-clavicular articulation, with convexity upwards, outwards to end behind middle of clavicle.

Ligature (Third stage) :—

Incision : Four inches long, half an inch above middle of clavicle.

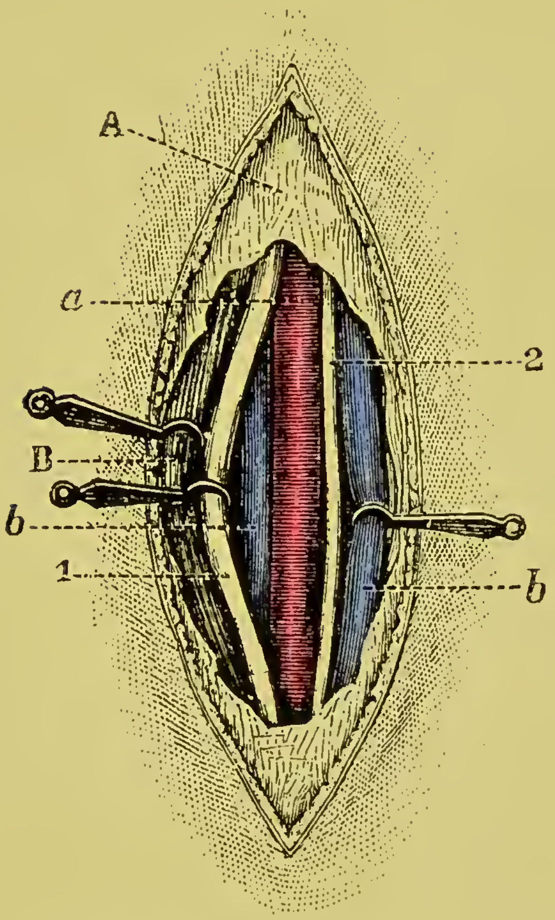
Avoid : External jugular vein by drawing down skin and cutting it on clavicle, then holding vein outwards. Supra scapular vessels frequently lie in front. Needle is passed from above, left finger being kept on the tubercle of the first rib. The subclavian vein is thus avoided. The lowest cord of the brachial plexus is above.

Ligature (Second stage) :—

Incision : Same line but more internal than last.

Avoid : Phrenic nerve along inner side of scalenus anticus, internal jugular vein more superficial and

PLATE I.—AXILLARY ARTERY.



1. Media nerve.
2. Ulnar nerve.

a. Axillary artery.

b. Veins.

B. Coraco brachialis muscle.

anterior, subclavian vein below and in front. The pleura below and behind.

Ligature (First stage):—

Incision: Three inches, upper border of clavicle, inner end, and along anterior border of sterno-mastoid.

Avoid: Pneumogastric and phrenic nerves and internal jugular and vertebral veins in front; recurrent laryngeal nerve below and behind.

INTERNAL MAMMARY.

Guide: A line from interval between heads of sterno-mastoid downwards to 6th rib, about half an inch from the sternum.

Avoid: Injury to pleura. *Vide* Plates II. and XIX.

INNOMINATE.

Guide: Line from middle of sternum, one inch below notch, to interval between sternal and clavicular origin of sterno-mastoid.

Incision: Three inches along clavicle and similar one along anterior border of sterno-mastoid.

Avoid: Left carotid and inferior thyroid vein on left, right innominate vein, pneumogastric and pleura on right, left innominate vein and thyroid plexus in front, trachea behind.

Vertebral:—

Guide: Scalenus anticus.

Incision: Three inches along posterior border of sterno-mastoid.

Avoid: Phrenic nerve outside, the vein in front, with sympathetic filaments, and inferior thyroid artery.

Note.—Contraction of pupil on same side usually occurs after this operation, owing to irritation or ligature of nerve from inferior ganglion of sympathetic.

Inferior Thyroid:—

Incision: Three inches in front of sterno-mastoid.

Avoid: Internal jugular vein, pneumogastric and sympathetic nerves and carotid artery in front. Recurrent laryngeal nerve inside, and on left side of body, the thoracic duct.

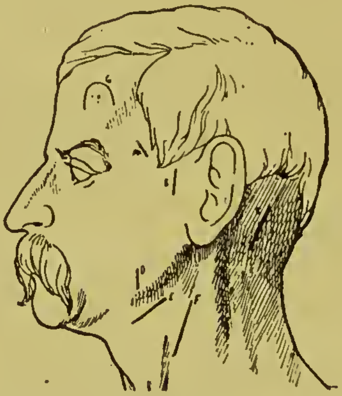


Fig. 4.

COMMON CAROTID.

A line drawn from the sterno-clavicular joint to a point midway between the mastoid process and angle of the jaw, marks the course of this vessel.

Lower part:—

Guide: Inner border of sterno-mastoid.

Incision: Three inches in length, ending at top of sternum.

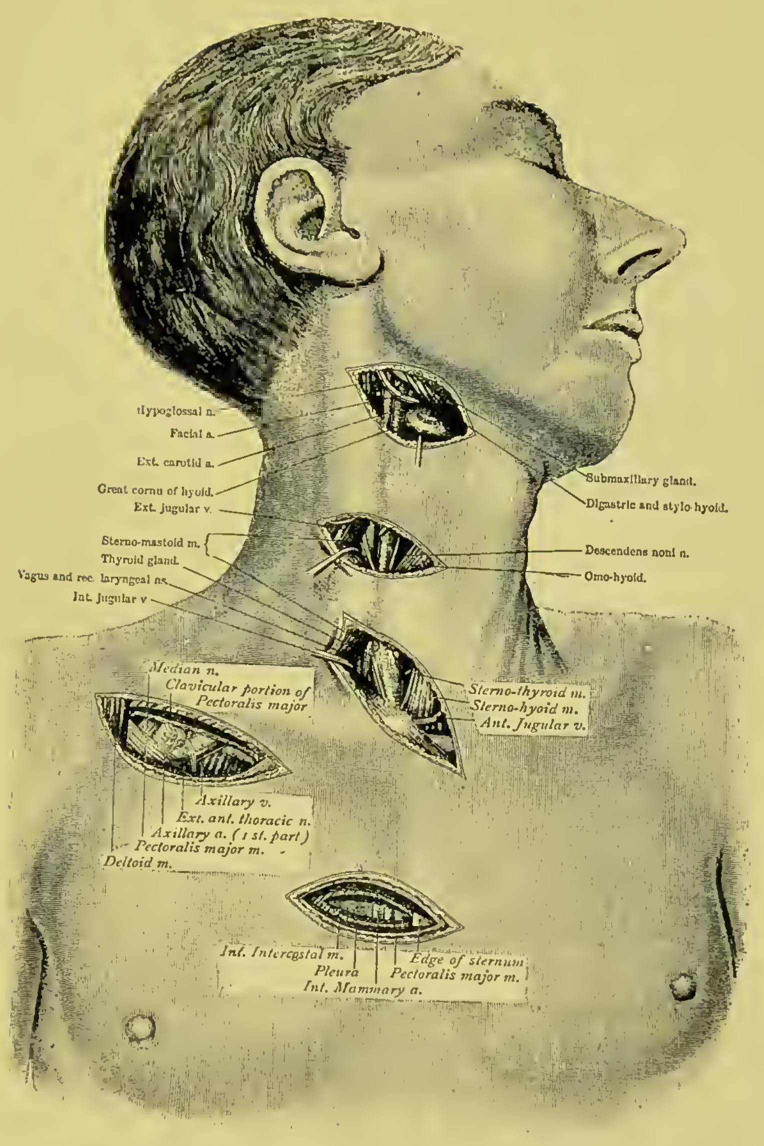
Avoid: Sterno-mastoid artery and middle thyroid vein in front; pneumogastric nerve and internal jugular vein on the outside, inferior thyroid artery, and recurrent nerve behind.

Upper Part:—

Guide: Inner border of sterno-mastoid.

Incision: Three inches in length, centre corresponding to cricoid cartilage.

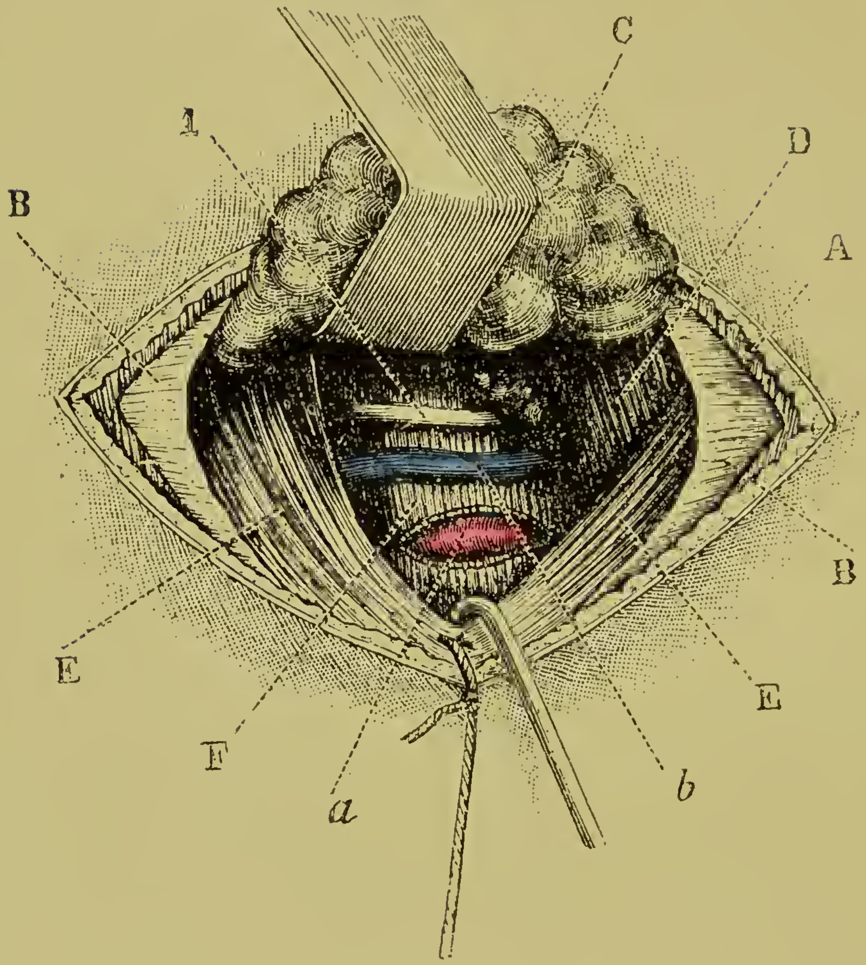
PLATE II.



(Köcher.)

The position of the vessels, and the lines of incision which give readiest access to them, is well shown in this Plate. Although the incisions are different from those usually adopted they give more room and are less likely to be followed by unsightly marks than the older ones.

PLATE III.—LINGUAL ARTERY.



1. Hypoglossal nerve.
a. Artery.
b. Ranine vein.
C. Submaxillary gland.
D. Mylohyoid muscle.
E. Digastric ,,
F. Hyoglossus ,,

Avoid: Descendens noni nerve, sterno-mastoid artery, and thyroid veins in front, jugular vein and pneumogastric nerve behind and outside.

External Carotid:—

Incision: Two and a half inches downwards from angle of jaw. Fig. 4, F.

Avoid: Superior thyroid, and fascial veins in front, superior laryngeal nerve. The deep guide to this artery is the tip of the cornu of the hyoid, and internal carotid.

Internal Carotid:—

Incision: Two and a half inches along anterior border of sterno-mastoid.

Avoid: Internal jugular and pneumogastric nerve on the outside, ascending pharyngeal and sympathetic ganglion behind, external carotid arteries and hypoglossal nerve superficially.

Lingual Artery:—

Guide: Upper border of hyoid.

Incision: Two and a half inches convex downwards, centre corresponding to greater cornu-hyoid. Fig. 4, E.

Avoid: Cutting through sub-maxillary gland (c, Plate III.), ranine vein (b, Plate III.), or opening pharynx.

ARTERIES OF LOWER EXTREMITY.

Dorsalis pedis:—

Line from midway between malleoli to first interosseous space.

Incision: One and a half inches between extensor pollicis and extensor longus digitorum.

Avoid: Nerve close on outside of artery.

ANTERIOR TIBIAL.

Line from central point between head of fibula and tubercle of tibia to midway between the malleoli.

Lower third :—

Incision : Two and a half inches along line through interval between tibialis anticus and extensor proprius pollicis.

Avoid : Nerve to outer side.

Middle third :—

Incision : Three and a half inches in line of artery along outer border of tibialis anticus.

Avoid : Going through the muscles and in passing needle see that the nerve lying in front is not included.

Upper third :—

Rarely ligatured, except for wounds, which, if present, may be enlarged, and bleeding points sought for.

POSTERIOR TIBIAL.

Line from centre of popliteal space to midway between internal malleolus and tendo-Achilles.

Ligature of lower third :—

Incision : Two inches curved with concavity towards inner malleolus and ending a half an inch below that part.

Avoid : Nerve behind and external, and tendon sheaths on either side and venæ comitæ.

Middle third :—

Incision : Four inches, three-quarters of an inch behind inner border of tibia, cutting tibial origin of soleus.

Avoid : Nerve on outer side.

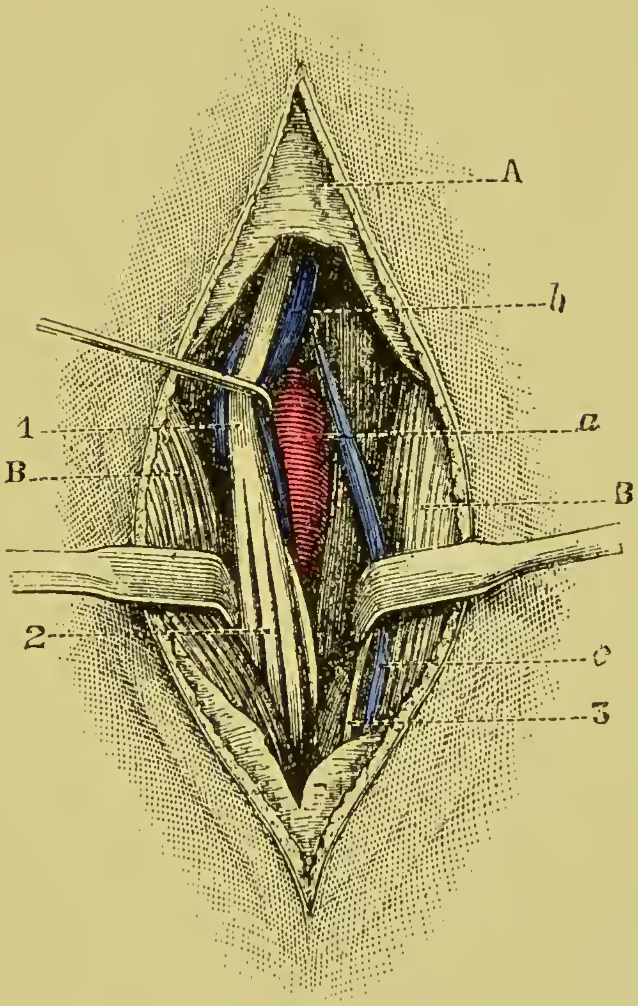
POPLITEAL ARTERY.

Lower part :—

Guide (superficial) : The central line of popliteal space. (Deep) Interval between the heads of gastrocnemius muscle, also short saphenous vein.

Incision : Three inches in middle line. Fig. 5, G.

PLATE IV.—POPLITEAL ARTERY.



1. Popliteal nerve.
2. Muscular branches.
3. Short saphenous nerve.

a. Popliteal artery.
b. Popliteal vein.
c. Short saphenous vein.

Avoid: Short saphenous vein and nerve, drawing them outwards. Internal popliteal nerve and popliteal vein drawing them inwards, as in Plate IV.

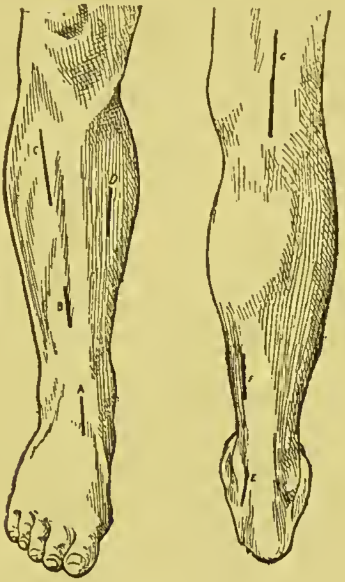


Fig. 5.

Upper part:—

Guide: posterior edge of adductor magnus.

Incision: Three inches, at junction of middle and lower third of thigh, as in Fig. 6, A.

Avoid: Internal cutaneous nerve; internal saphenous vein. The artery is found between semi-membranosus and the great adductor.

SUPERFICIAL FEMORAL ARTERY.

This vessel runs from midway between symphysis pubis and anterior superior spine of ilium to the tuberosity of the internal condyle, the thigh being flexed, abducted, and rotated outwards.

In Hunter's canal:—

Guide (superficial): Line above-mentioned. (Deep) outer border of Sartorius, and transverse fibres of Hunter's canal.

Incision: Three inches, in middle third of thigh Fig. 6, B.

Avoid: Saphenous vein superficially, and internal saphenous nerve in front and to the outer side. The tendon of the adductor magnus must not be tied instead of the artery; its own vein lies behind and to the outer side.

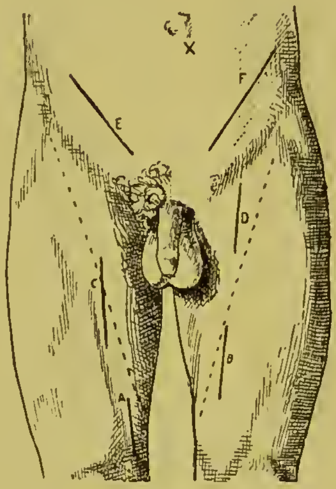


Fig. 6.

At apex of Scarpas' triangle :—

Guide: Inner edge of Sartorius.

Incision: Three inches in line of artery; the centre corresponding to the apex of triangle. Fig. 6, C.

Avoid: In front, branches of saphenous vein and internal cutaneous nerve. On the outer side, long saphenous nerve; its own vein lies behind and must not be wounded in passing needle.

Common Femoral :—

Incision: Two inches, commencing a little above Poupart's ligament in line of artery. Fig. 6. D.

Avoid: Apogastric and circumflex iliac vessels, and geni to crural nerve in front. Its own vein within the anterior crural nerve does not lie close to the artery on its outer side.

ILIAC ARTERIES.

These vessels, formed by the bifurcation of the aorta, are marked by lines, commencing a finger's breadth below, and to the left of the umbilicus (x, Fig. 6), and running downwards and outwards to a point midway between the anterior superior spine of the ilium, and the symphisis pubis.

External Iliac:—

Incision: Three and a half inches in length, slightly concave upwards, a finger's breadth above Poupart's ligament, and commencing 1¼ inches from the spine of the pubis. Fig. 6, E.

Avoid: Opening the peritoneum, or wounding the deep epigastric artery. Strip the vessels with the fingers and pass aneurism needle from inner side to avoid iliac vein.

Common Iliac:—

Incision: Five inches in length, commencing 1½ inches above the middle of Poupart's ligament, curving upwards and outwards, past a point 1½ inches internal to the anterior superior spine of the ilium, and turning upwards towards ribs.

Avoid: Opening the peritoneum; avoid ureter, pushing it upwards and inwards. The aneurism needle, with curved end at right angles to shaft, should be passed from right to left of both sides, in order to avoid vein.

AMPUTATIONS.

The infinite variety of methods of amputation renders it impossible for you to master the details of all, so I am satisfied with giving descriptions of a few reliable procedures.

The steps in a properly conducted amputation are:—

The limb, which has been shaved and washed with soap and water, is raised to empty it of blood, and enveloped in a large towel (which has been saturated with 1–500 corrosive sublimate solution and dried); over this Esmarch's bandage is applied, and then the rubber tube is made to catch the towel when encircling the limb above the bandage. On removing the bandage and turning up the towel, the field of operation is protected from infection from above. Ether, followed by corrosive sublimate 1–1000, renders the parts aseptic, and all the neighbourhood must be rendered equally so by spreading aseptic towels carefully over everything likely to be touched by the operator, or his assistants.

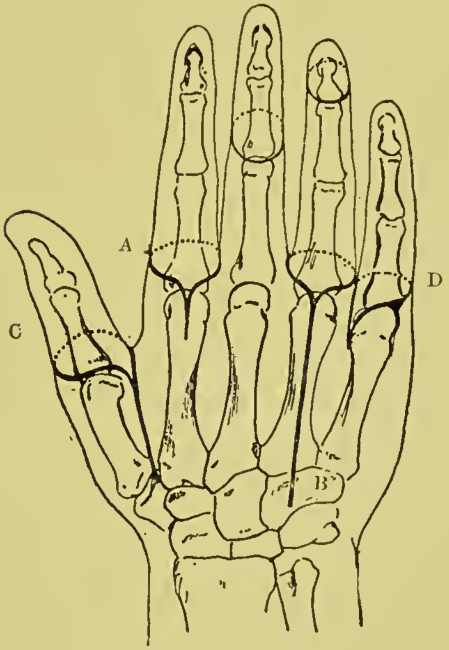
The points to be attended to in all operations are:—

1. Never cut the flaps short.
2. Be careful that the flaps have a proper blood supply.
3. In raising a flap avoid cutting towards the skin, or you may cut its vessels of supply.

Amputation at Metacarpo-pharyngeal Joint.

The finger to be amputated is held in the left hand by the operator, and an assistant should hold the adjacent fingers aside. The knife is then to be introduced over the centre of the dorsal aspect of the joint, and carried round the palmar aspect of the finger a little below the palmar fold, returning to the point where the incision commenced; flexing the finger, the extensor tendon is divided, the joint opened, the lateral ligaments and the remaining soft parts cut through.

PLATE V.—INTERPHALANGEAL AND CARPO-METACARPAL DISARTICULATIONS.



A. Amputation of index finger.

B. Amputation of middle finger and metacarpal bone.

C. Amputation of thumb and metacarpal bone by Racket incision.

D. Amputation of little finger.

AMPUTATION OF THUMB AND METACARPAL BONE.

An assistant should grasp the fingers while the surgeon abducts the thumb. The knife may be introduced into the centre of the web, and passed towards the trapezium, beneath the muscles of the thumb (Fig. 7.), made to emerge at the base of the metacarpal bone, and then by cutting outwards a rounded flap is formed, comprising the whole of the tissues of the ball of the thumb. The extremities of this flap are now united by a straight incision across the dorsal aspect, and the thumb being held still strongly abducted, the remaining soft tissues are divided, the joint opened on the inner side, and the disarticulation completed. The flap may be formed by introducing the knife at the base of the metacarpal bone, and bringing it out at the centre of the web.

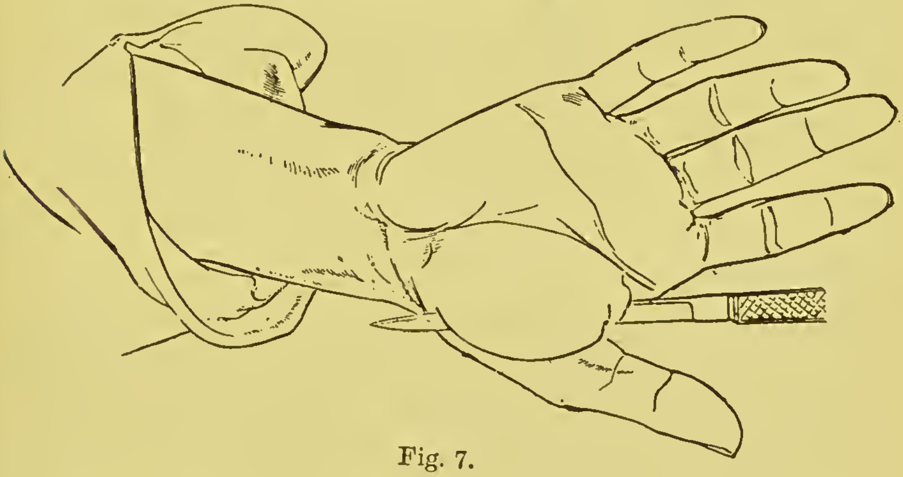


Fig. 7.

DISARTICULATION AT WRIST.

The external flap method, as in Fig. 8, is useful when the palmar and dorsal skin at ulnar side of hand is affected; but the circular or the antero-posterior flap methods are admissible at the wrist as in the forearm. Teale's amputation with the long flap on the extensor aspect of the forearm leaves a good stump but a double flap—the dorsal one by dissection, the flexor one by transfixion—is a rapid method of amputating through forearm.

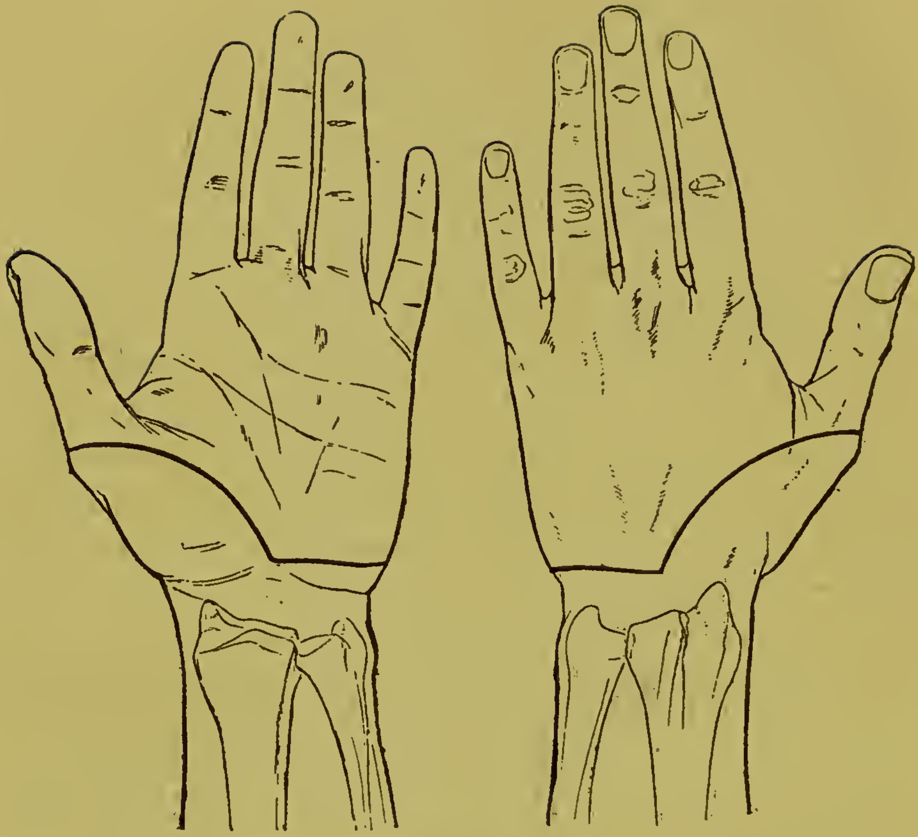


Fig. 8.

DISARTICULATION AT ELBOW.

Operation.—According to the circumstances of the case, the flap method or the circular may be adopted. When the former is selected, the flaps may be antero-posterior, lateral, a long anterior single flap, long posterior flap, or Teale's method may be practised. A single lateral flap, taken either from the inner or the outer aspect of the limb, will also be found to afford an excellent result. The long anterior flap is the method usually selected (Fig. 9), and this may be formed either by transfixion, the forearm being flexed, or by cutting from without inwards. It should be from three to four inches in length, and its base made to correspond with a line a half to three-quarters of an inch below the condyles.

After the flap is dissected up to the joint, the capsule and lateral ligaments are cut through, and a short posterior flap formed. This is best accomplished by cutting from without inwards, so as to detach the soft parts from the olecranon.

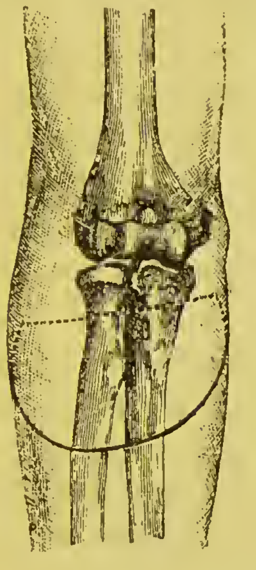


Fig. 9.

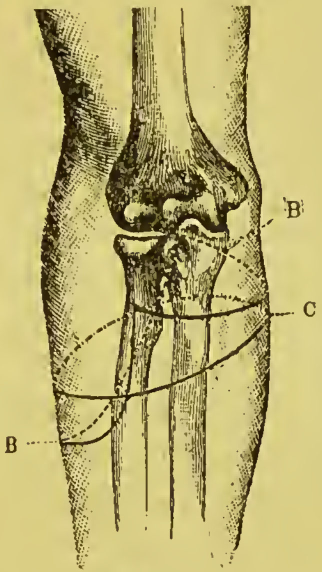


Fig. 10.

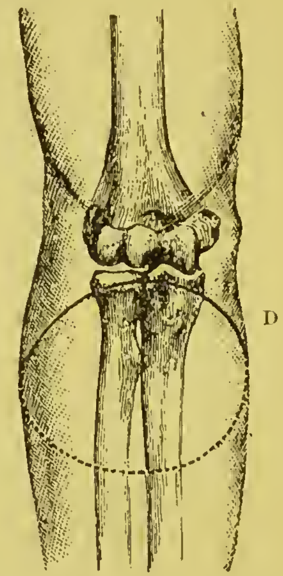


Fig. 11.

AMPUTATION OF ARM.

The Circular Operation.—This can be executed more quickly by the following than by the ordinary method:—Stand upon the right side of the limb, the left foot thrown forward and placed firmly upon the floor, the right knee bending sufficiently to give freedom of motion to the body; grasp the limb above the point of operation with the left hand, and take the handle of the knife between the thumb and fore and second fingers of the right hand, lightly supported by the other fingers; stooping sufficiently to allow the right arm to encircle the limb readily, carry the knife around until the blade is nearly perpendicular to the long axis of the limb on the side next to you with the point downwards, and the hand above the limb. Commence the cut with the heel of the knife, giving slightly sawing motions, and bring the hand under the limb, and then directly upwards upon the side next to you, until the heel touches the point of commencement; the handle of the knife held thus delicately will change its relative positions as it passes around the limb without the slightest embarrassment to the operator; if the handle is firmly grasped in the hand, the incision cannot be completed without the aid of the other hand, or an awkward movement of the hand holding the knife; the ease with which the incision is completed will depend much upon whether it commences well down upon the side of the limb next to the operator. Raise the skin from the first layer of muscles by dissection, and turn it upwards, two or three inches according to the diameter of the limb, like the cuff of a coat. Divide the first layer of muscles at the margin of the retracted integument by the circular incision, as of the skin; raise this layer with the knife, and draw it still further upwards; divide the last layer of the muscles down to the bone (Fig. 12) by the same sweep of the knife as before given. Saw the bone at the apex of the cone.

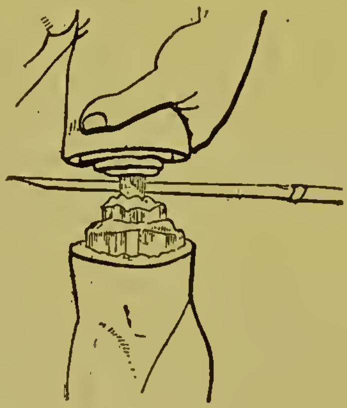
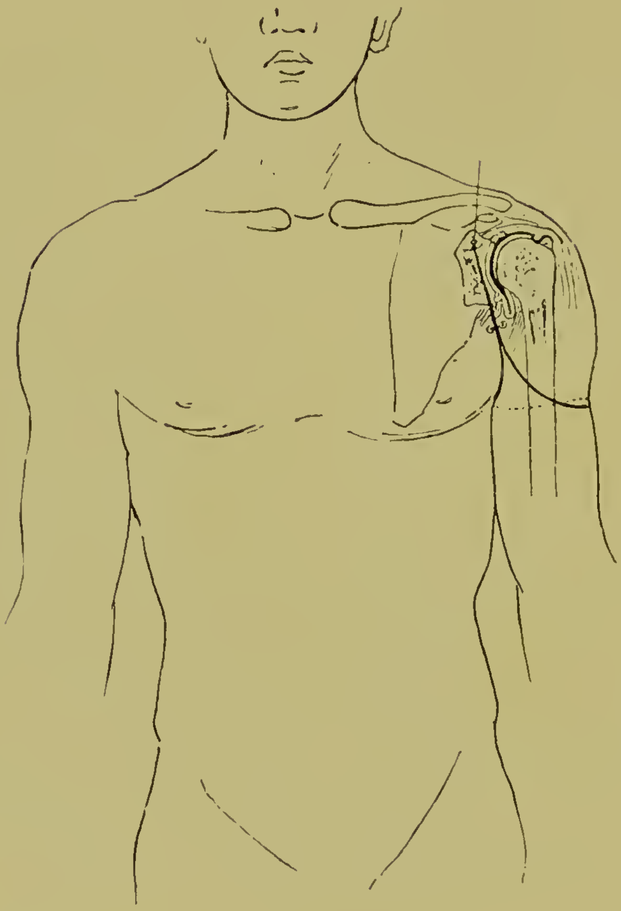


Fig. 12.

DISARTICULATION OF SHOULDER.

Oval Method.—Entering the knife at the acromio-clavicular joint, an incision should be made vertically

PLATE VI.—DISARTICULATION AT SHOULDER.



This Plate shows the anterior, Fig. 13 the external, and Fig. 14 the posterior Racket incision for removal of the arm.

downwards in the direction of the bicipital groove (Fig. 13), dividing all the tissues to the bone for a space of four inches. The knife is now carried transversely outwards, close above the insertion of the deltoid, still cutting deeply, and brought round the back of the arm to the inner side. The incision terminates by joining the wound first made, care being taken at this stage to divide only the skin and subcutaneous tissue, on the inner side of the arm. The external flap is to be detached from the upper and outer surface of the joint; a transverse incision is made in the capsule, and the muscles

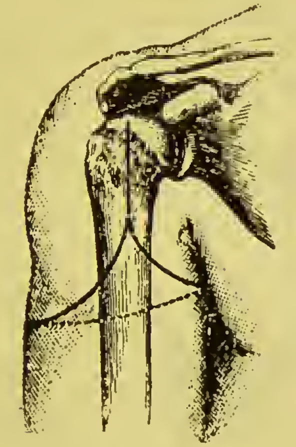


Fig. 13.

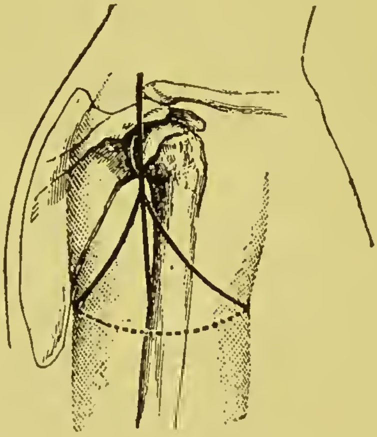


Fig. 14.

inserted in the greater and lesser tuberosities divided near their insertions by cutting at right angles to the surface of the head of the bone, while the arm is alternately rotated inwards and outwards. (In order to open the articulation most readily, the knife may be placed in the bicipital groove and run up along it into the shoulder-joint, following the long tendon of the biceps.) The assistant now presses the elbow upwards and pushes the head out of the wound, which is grasped by the surgeon's left hand, and the external flap being retracted, the posterior part of the capsule is divided, and the knife made to cut from within outwards and downwards, keeping it first quite close to the bone, thus avoiding the trunk of the posterior circumflex artery and only dividing the axillary vessels at the last moment, the assistant meanwhile grasping them in the posterior flap before their division. The knife is thus made to emerge from the wound previously marked out, and the parts come together very accurately, and in a position well suited for effective drainage.

TARSO-METATARSAL OPERATION.

HEY—LISFRANC.

Lisfranc's Operation.—The anterior incision across the dorsum of the foot should begin and end opposite the articulation of the first metatarsal with the internal cuneiform on the inner side, and the top of the fifth metatarsal on the outer side. These two points should be carefully determined beforehand. The foot to be amputated should be firmly held on its plantar surface with the left hand of the operator, the tip of

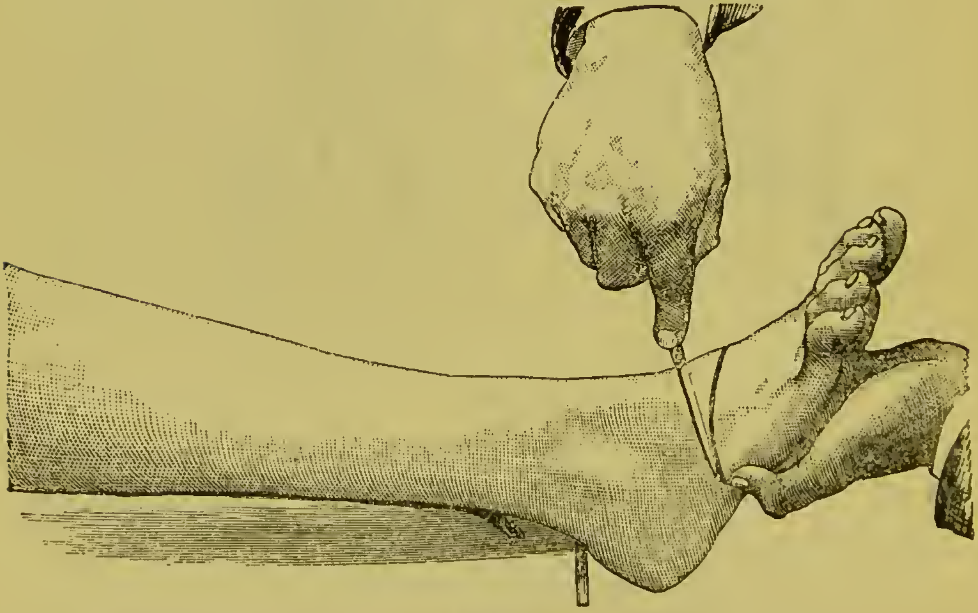
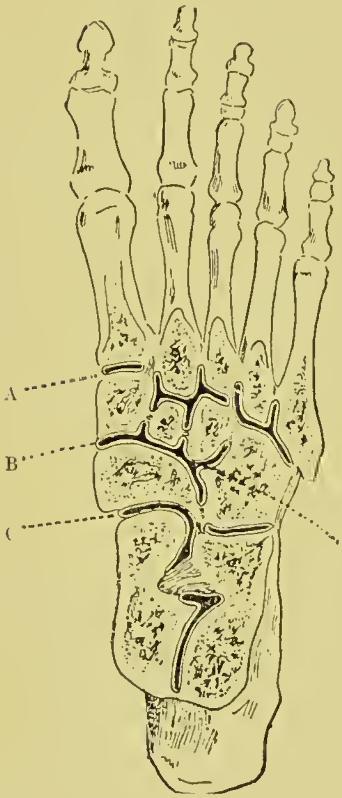


Fig. 15.

PLATE VII.—LINES OF AMPUTATION.



A. Tarso-metatarsal.—*Hey; Lisfranc.*
B. Anterior intertarsal.—*Jäger.*
C. Post intertarsal.—*Chopart.*

N.B.—Lisfranc disarticulates the second metatarsal from between the cuneiform bone, while Hey by sawing in the line of the tarso-metatarsal joint (A) leaves the base of that bone in position.

The dorsal incision should be more convex downwards than is shown in Fig. 15.

sole of the foot; and, in order to do this more accurately, a deep groove should be cut from without inwards, holding the foot well upwards by the toes, and extending the lateral incisions first made along the inner and outer margins of the foot and across the bases of the toes close to the web.

The articulation having been now laid open, seize the upper part of the foot with the left hand and depress it strongly, cut through the interosseous and plantar ligaments; the knife is then introduced behind the metatarsus, and the plantar flap completed by cutting from within outwards. If it be preferred, however, the flap, as before stated, may be formed by cutting wholly from without inwards, as this is much the better plan.

MEDIO-TARSAL AMPUTATION.

Chopart's Operation.—The foot is held and the flaps are made in a similar way to those for Lisfranc's amputation. The plantar flap, however, must be one inch shorter, taking care that its inner margin shall be nearly an inch longer than

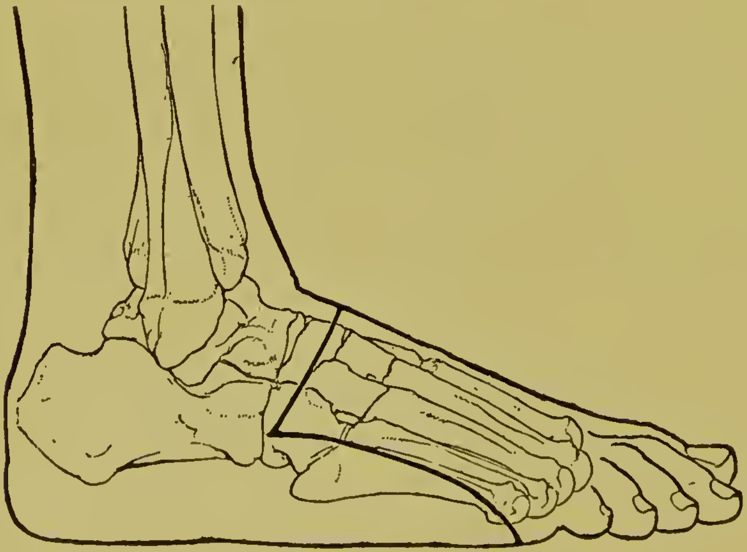


Fig. 16.

the outer. In other words make the incision parallel to the bases of the toes, thus crossing the sole obliquely and not transversely. Make the anterior incision with the convexity extending downwards nearly half an inch below the line of the articulation (Figs. 16 and 17), and, dividing only the skin, terminate it on each side over the inferior part of the articulation. The skin being retracted, divide the tendons with the next sweep of the knife over the line of the joint, which will at once be opened. Now mark out the plantar flap by means of a deep groove cut through the sole with the knife, crossing obliquely one inch behind the bases of the toes. Then seizing the upper part of the foot with the left hand, complete the division of the ligamentous structures and the plantar flap by cutting from within outwards.

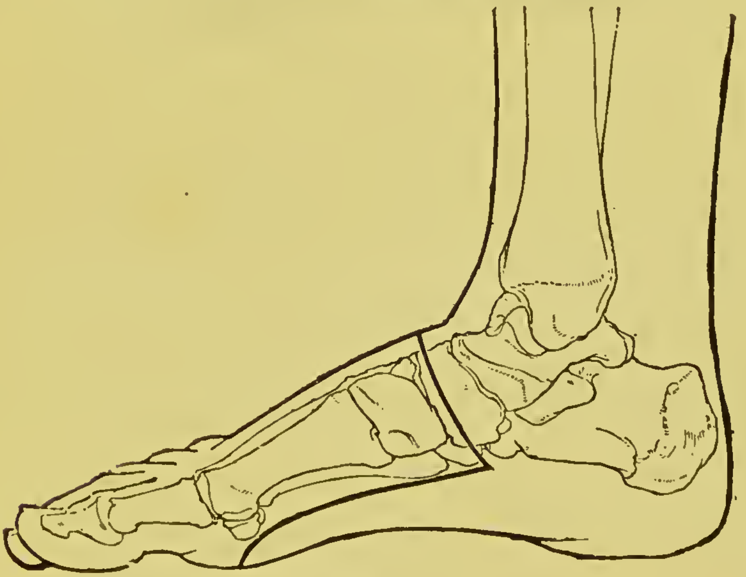


Fig. 17.

AMPUTATIONS AT ANKLE.

Roux's Operation.—Commence the incision at the outer border of the tendo-Achilles, continue it half an inch below the external malleolus, and across the front of the ankle-joint at the same distance below the line of the articulation as far as a point a little in front of the internal malleolus. The knife should then be carried directly downwards and across the sole of the foot, and finally made to slope obliquely upwards and backwards, to join the incision first made at a very acute angle (Figs. 18 and 19). The knife should be made to divide all the soft parts down to the bone in the first incision.

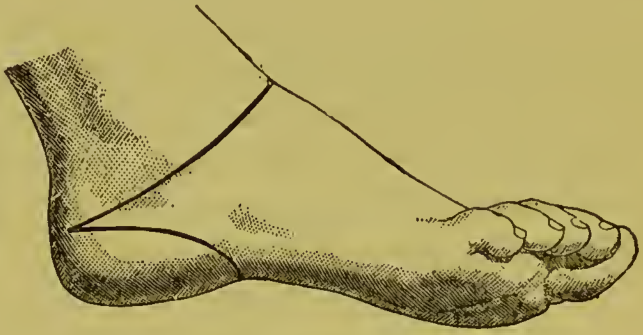


Fig. 18.

The edge of the anterior flap is now dissected up and the ankle-joint opened. It will be needful to make vigorous use of the left thumb in detaching the heel-pad from the os calcis from without inwards as far as its inner border. The disarticulation should now be completed from the front, the soft parts being well held back by a retractor. The remain-

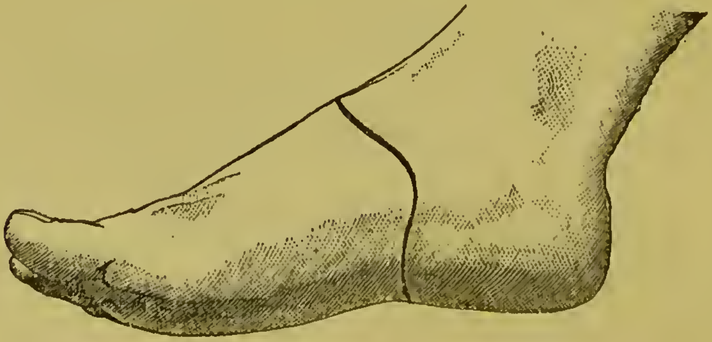


Fig. 19.

ing structures on the inner side of the joint can be easily cut through, the tendo-Achilles divided, and the disarticulation completed. As in other amputations at the ankle-joint, the malleoli should be sawn off flush with the articular surface of the tibia.

Syme's Operation.—The patient must be placed in the position already described, the surgeon standing before the foot, the front part of which should be held in the left hand. In the right foot a vertical incision is first made round the side from the tip of the external malleolus, which will be a point rather nearer its posterior than its anterior margin, to a point precisely opposite to it on the inner side of the foot, that is to say, terminating three-quarters of an inch below and a little behind the tip of the internal malleolus (Fig. 20).

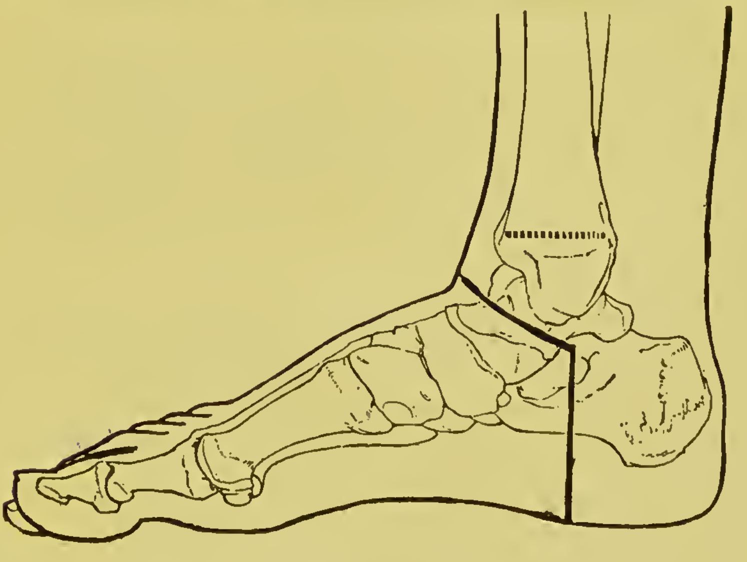


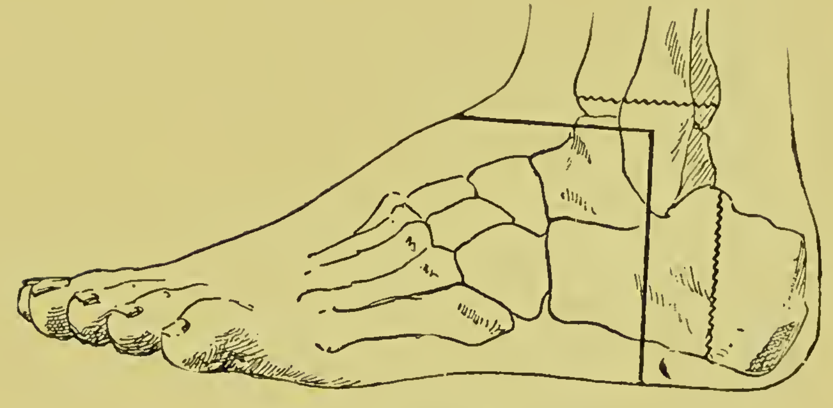
Fig. 20.

SYME'S AMPUTATION.

For the left foot the incision must be reversed. All the soft parts are to be divided right down to the bone. The thumb of the left hand is now introduced into the centre of the incision and the soft parts are gradually detached from the os calcis, by short cuts of the knife made quite close to the bone until the insertion of the tendo-Achilles be reached. This portion of the operation is fatiguing and difficult, especially if the parts prove infiltrated by inflammatory products. Then the upper surface of the foot is to be taken firmly in the left hand, and the extremities of the incision first made, united by one made directly across the ankle-joint. The foot being forcibly depressed, the extensor tendons are readily divided and the joint opened. The soft parts and ligaments on the lateral aspects and the insertion of the tendo-Achilles are now to be cut through, keeping close to the bone. Care must be taken when separating the parts from the tuberosity of the os calcis, as otherwise one or more button-holes will be made in the flap, the skin being very thin. This will be avoided by taking care always to cut close to the bone. The removal of the foot is now completed; the soft parts being retracted, a circular cut is made with a strong scalpel round the lower end of the tibia and fibula, immediately above the level of the articular surface of the tibia, and the malleoli and joint surfaces removed with the saw; the thinnest possible layer being cut off the tibia.

Pirigoff's Operation.—The incisions made through the soft parts are similar to those adopted for Syme's amputation. After the plantar incision is complete, the soft parts are not to be detached from the heel, but the foot is at once disarticulated after making the dorsal incision. Holding it in the left hand and sufficiently depressed, the saw is applied to the upper surface of the os calcis just behind the sustentaculum tali, and the bone divided vertically downwards—that is, in a direction corresponding to the margins of the plantar flap, any undivided soft parts being first separated by a circular sweep of the knife, so that the incisions through the bone and soft parts shall be in one plane. The extremities of the tibia and fibula are now to be removed in the same manner

PLATE VIII.—DISARTICULATION OF FOOT.



(Pirigoff).

This figure shows the skin incision and the lines of section of the bones in the osteoplastic operation of Pirigoff. It is an admirable procedure when the operation is conducted for traumatisms, but when carried out for tubercular or other infective bone troubles it is not to be recommended, as the piece of os calcis left is almost certain to become troublesome sooner or later.

as in Syme's amputation, and after the bleeding has been arrested the posterior flap and cut surface of the os calcis can be exactly applied to the cut surface of the tibia, and the soft parts sutured together.

AMPUTATION OF LEG.

Teale's Amputation.—The operator makes a longitudinal incision on either side of the limb (Fig. 21), in length equal to two-thirds of the circumference of the limb at this part; a second incision, extending to the bone, unites the lower extremities of these two incisions: this quadrilateral flap is raised from the bone; a third incision made transversely down to the bone, forms the posterior flap; both flaps are raised and firmly retracted, the bone sawn at its point in the flaps, and the flaps united.

The lateral incisions should fall behind the inner edge of tibia and the fibula, and in elevating the anterior flap the thumb should be used to separate the soft tissues

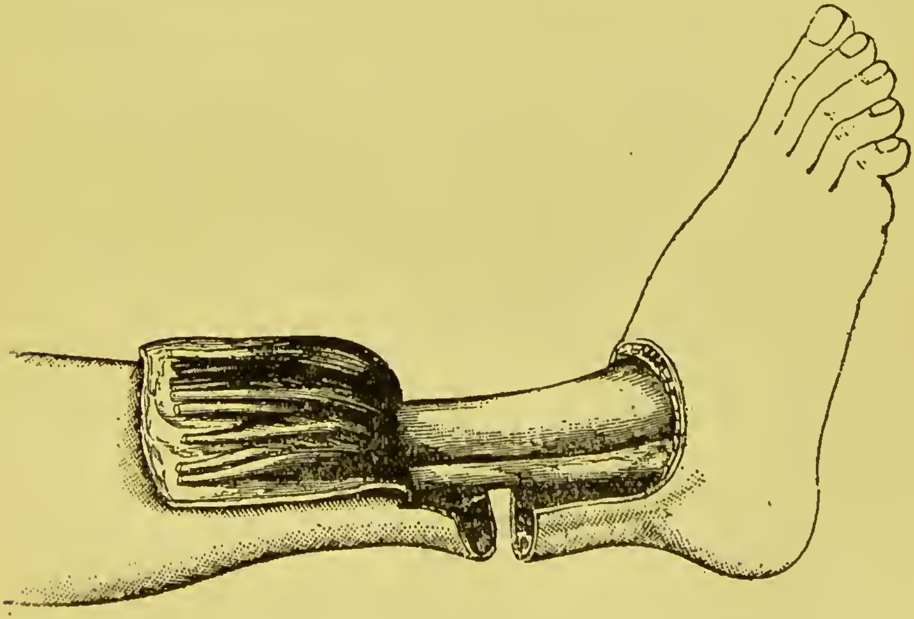


Fig. 21.

from the interosseous membrane. The knife is only required for the attachments of the inter-muscular septa along the bones. Any dissecting up of the flap would mean wounding

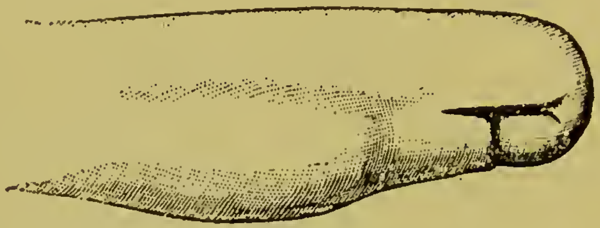


Fig. 22.

the anterior tibial artery. Fig. 22 shows how the flaps should be brought together.

Lateral Flap Method.—The surgeon standing in front of

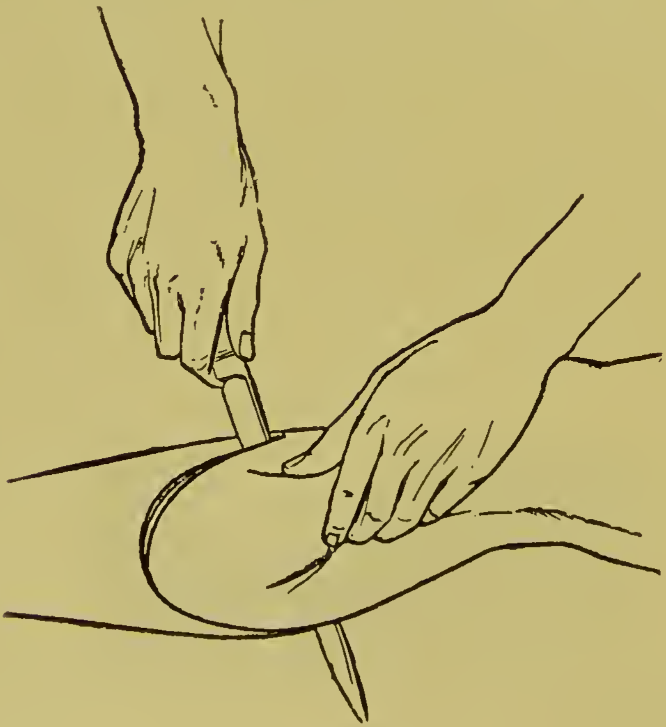


Fig. 23.
(Sedillot.)

PLATE IX.

DISARTICULATION AT KNEE.

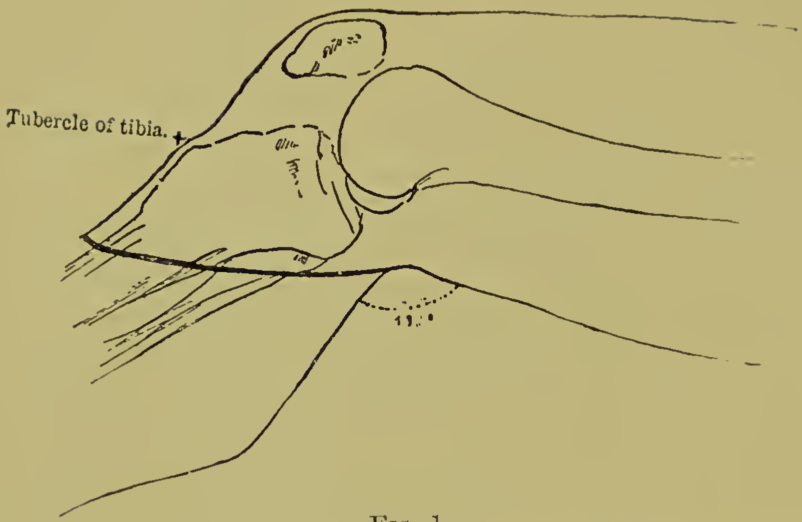


FIG. 1.

This operation by oblique oval incision gives free access to the joint, provides for a large well-nourished flap, and allows transverse section of the great vessels of the leg at the shortest portion of the flap.

SUPRA-CONDYLOID AMPUTATION.

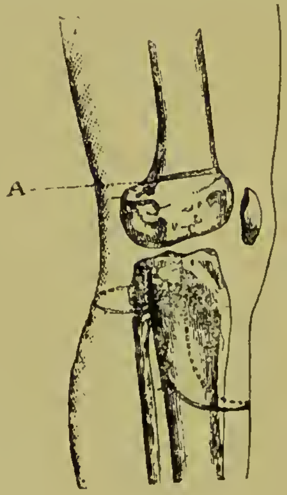


FIG. 2.

Farabeuf.

The anterior flap consists of skin and subcutaneous tissue; the posterior contains all the structures in the popliteal space.

the limb and having its external surface held upwards, seizes the skin and muscles over the upper outer part of the leg in his left hand, and lifts them off the fibula (Fig. 23). He then enters the point of a transfixion knife about two fingers' breadth below the tubercle of the tibia and one finger's breadth external to the crest. He transfixes the limb from before backwards towards the fibula, touching this latter bone and bringing the point out about two fingers' breadth above the level of the point of entrance. He then cuts downwards and forms a flap about four inches in length, formed of the peroneal and part of the gastrocnemius muscles. An assistant retracts the flap, and the operator then divides the soft parts on the inner side by an incision from one end of the flap to the other in a circular manner, with a slight convexity directed downwards. The internal incision can also be begun and ended a little below the base of the flap, and so more skin preserved. The operator then clears the remainder of the muscles from the bones, so as to allow the application of the saw close below the tubercle of the tibia.

DISARTICULATION AT KNEE.

Stephen Smith's Operation.—Commence the incision in front one inch below the tubercle of the tibia and carry it downwards and forwards over the front of the leg; laterally the incisions should curve moderately downwards on each side of the leg till they reach the posterior surface, when they curve upwards and meet in the ham in the median line, being continued directly upwards as far as the line of the articulation. The skin, fascia and cellular tissue are now reflected, the ligamentum patella divided, and the joint structures severed. The patella is left. The inner flap should be somewhat longer to ensure sufficient cover for the larger internal condyle.

Gritti's Operation.—The operation can be performed by making an incision commencing on the inner or outer side of the joint opposite the line of the articulation, and passing across the front of the limb a little below the tubercle of the tibia so as to form a somewhat square-shaped flap (Fig. 24). The base of the anterior flap is equal to half the circumference of the limb. The convexity should extend about one inch below the insertion of the ligamentum patellæ. This flap, containing the patellæ and surrounding structures, is now reflected, the articulation opened, and the short posterior flap made by cutting from within outwards. The shape of the posterior flap may be first mapped out with advantage. The condyloid extremity of the femur is then sawn off, and the articular surface of the patella. After the bleeding points are carefully secured, the anterior flap is turned down and the patella fastened to the cut surface of the femur by one or two silver sutures, which are twisted and cut short, the flaps being united and drainage tubes inserted in the ordinary way.

Stokes' Operation.—Stokes saws through the femur at a point one-half to three-quarters of an inch above the upper margin of the cartilage of encrustation. The medullary cavity of the femur will not be opened, and tilting forward the patella is avoided. The anterior flap should be oval, extend from a point one inch above either condyle to the other, and reach downwards as far as the tubercle of the tibia. A posterior flap, at least one-third the length of the anterior, is then made by cutting from without inwards. After the bones have been sawn through, the patella, with its articular surface shaved off, should be fastened to the cut extremity of the femur by buried sutures of wire or chromicised catgut.

Carden's Operation.—The operation is best performed by a

PLATE X.—AMPUTATION THROUGH CONDYLES.

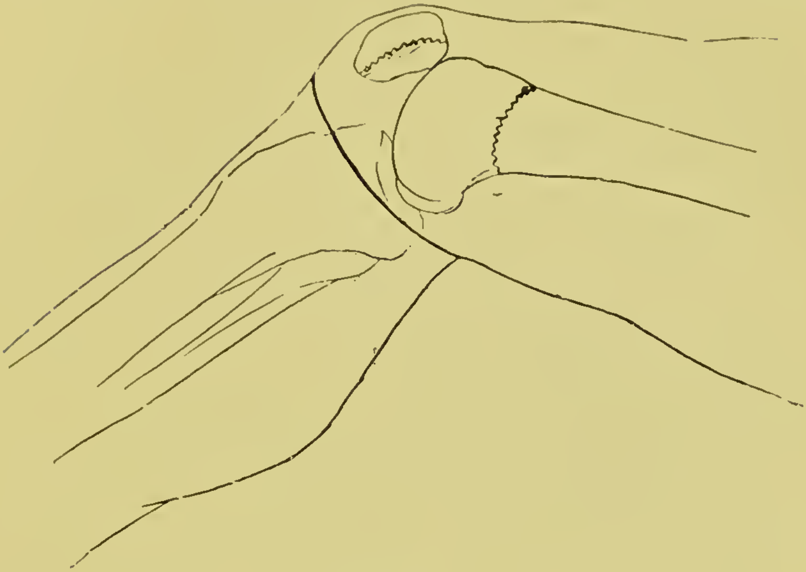


Fig. 24.

(Gritti's).

Osteoplastic Supra-Condyloid Method.

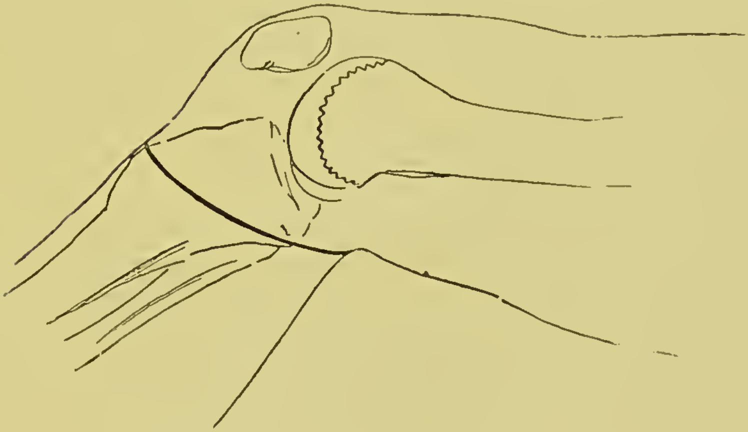


Fig. 25.

Carden's Trans-Condyloid.

These figures show the lines of section of the bones in the methods above described. The line of section in Stokes' operation would be midway between those here depicted.

long anterior flap made by cutting from without inwards, and a shorter posterior flap formed by transfixion, similar but slightly higher up than the flap lines in Fig. 25. Carden did not advise a posterior flap, but it is certainly necessary to make one, as the soft covering will otherwise be insufficient. The anterior flap, made in a manner similar to that in Gritti's operation, should extend as far as the insertion of the ligamentum patellæ and have a broad extremity. It should be turned upwards after the knee-joint is laid open. The patellæ is dissected carefully out keeping as close as possible to the bone. The remaining ligaments of the joint are divided and the posterior flap is formed. The soft parts are now to be retracted and the condyles sawn off, the stump being treated as before described. In cases of disease the synovial pouch may be dissected out and a more speedy union accomplished. Where the amputation is performed for injury this proceeding is unnecessary.

AMPUTATIONS AT THIGH.

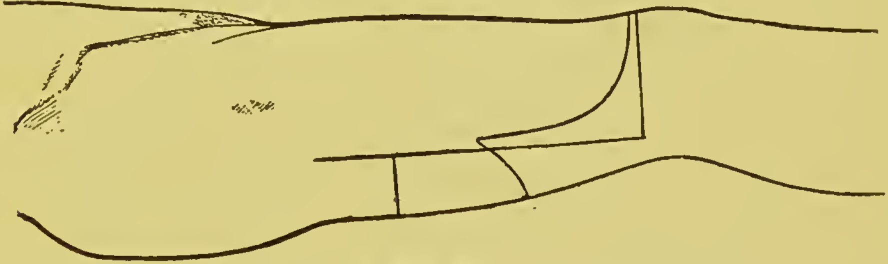


Fig. 26.

Lines marking the incisions necessary in double flap and Teale's amputation of thigh.

Disarticulation at Hip.

Operation.—The exact position of the joint should be first carefully determined. The operator must stand on the outer side of the limb to be removed. The thigh being slightly flexed and rotated outwards at the hip-joint, a long knife is introduced immediately below the anterior superior spine. The point of the knife is made to travel in a direction parallel to Poupart's ligament and through the anterior portion of the capsule of the hip-joint, which it should open, and is then made to emerge at the junction of the thigh with the perinæum, as low down as possible in the direction of the ischial tuberosity. The knife is made to cut downwards for about four or more inches, and then outwards. The flap should be from six to ten inches long, according to the size of the limb.

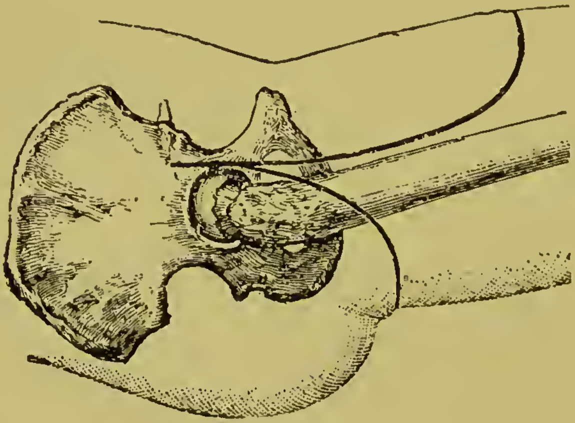
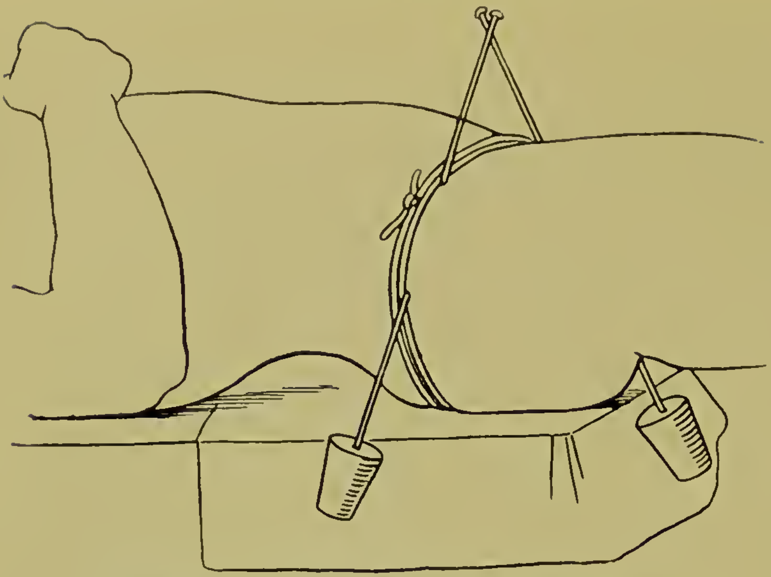


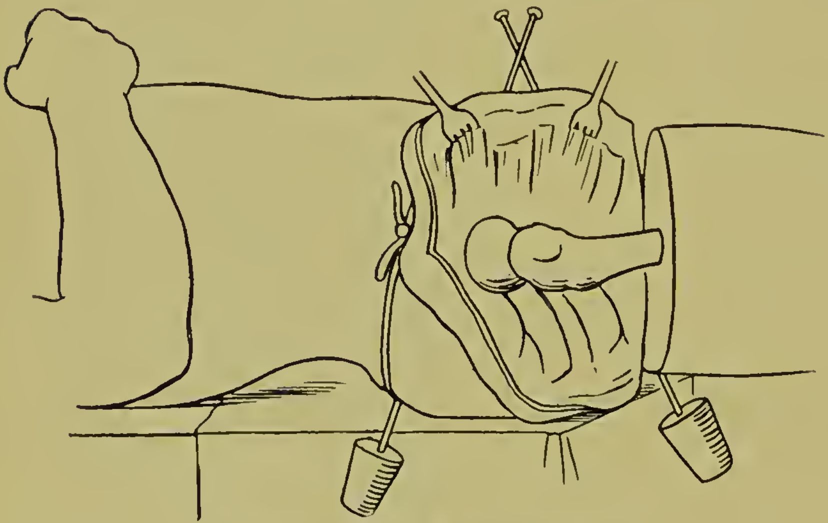
Fig. 27.

The next step of the operation consists in disarticulating the joint. The limb is forcibly extended and rotated outwards, and the knife drawn transversely across the capsule and the muscles on both sides. The head will start forwards, and the ligamentum teres can be divided, if present, from the inner side. To do so the point of the knife should be introduced at the notch of the acetabulum, the head of the femur being rotated outwards, and the limb abducted.

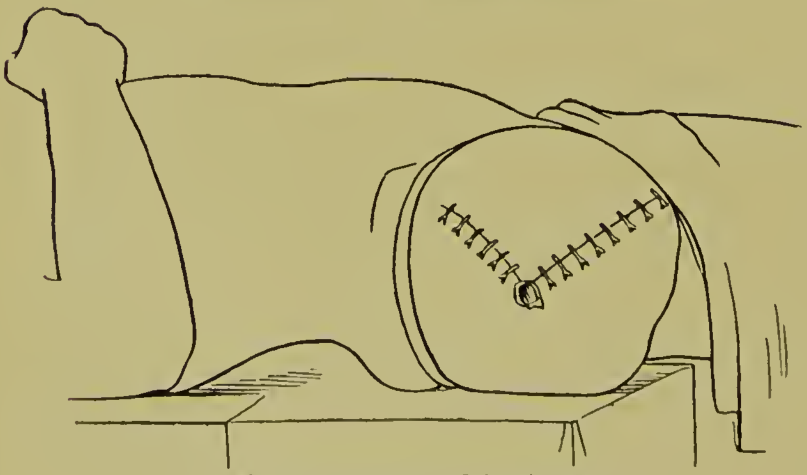
PLATE XI.—DISARTICULATION AT HIP.



Transfixion to support Esmarch's Elastic Tube.



Retraction of Flap Exposing Joint.



Method of Suture and Drainage.

The operator having seized the head with his left hand and pulled it forward, divides the posterior part of the capsule, and the limb being rotated inwards slightly, the muscles inserted in the great trochanter are severed by transverse incisions cutting close to the bone. The head and great trochanter are in this way completely freed, and the limb being held straight, the operation is completed by cutting downwards and outwards with the amputating knife, the skin being divided about two inches below the fold of the buttock.

Method of preventing hæmorrhage in amputation of hip:—

1st. Preliminary ligature of the vessels.

2nd. Digital compression of femoral or external iliac.

3rd. Lister's aortic tourniquet.

4th. Davy's lever passed through the rectum to compress the common iliac.

5th. Esmarch's elastic tourniquet; and

6th. The method of controlling hæmorrhage by the application of the elastic band, described by Mr. Jordon Lloyd, which is at once simple and effectual. He describes it thus:—

The limb about to be operated upon should first be emptied of blood by elevation. This will occupy only a few minutes, and may be executed during the administration of the anæsthetic. A strip of black india-rubber bandage about two yards long is to be doubled and passed between the thighs, its centre lying between the tuber ischii of the side to be operated on and the anus. A common calico thigh-roller must next be laid lengthways over the external iliac artery. The ends of the rubber are now to be firmly and steadily drawn in a direction upwards and outwards, one in front and one behind, to a point above the centre of the iliac crest of the same side. They must not be pulled tight enough to check pulsation in the femoral artery. The front part of the band, passing across the compress, occludes the external iliac, and runs parallel to and above Poupart's ligament. The back half of the band runs across the great sacro-sciatic notch, and, by compressing the vessels passing through it, prevents bleeding from the branches of the internal iliac artery. The ends of the rubber are crossed in the hand of an assistant, the back of his hand should be supported by the middle of the iliac crest.

OPERATIONS ON JOINTS.

The named operations which are carried out on joints, may be grouped under the following heads :—

Arthrotomy, or the cutting into a joint for the purpose of evacuating pus, serum, blood, &c.

Arthrectomy or Erasion : Where the joint is freely opened for the removal of diseased products (synovial membrane chiefly), with the hope of leaving a movable joint.

Resection or Excision ; In this operation the bone ends are sawn off, and the original joint obliterated. In resection of the joints of lower extremity the object is to produce a stiff joint, whereas in the upper extremity a movable, and yet useful, one is possible. Care must be taken not to produce a flail limb in our efforts at obtaining motion.

The indications for resection are :—

1. Localised tuberculosis of synovial membrane, or bone ends.
2. Old dislocations which are irreducible.
3. Faulty position after fracture, or other injury or disease of a joint.
4. Where a flail limb exists as a result of laxity of ligaments and muscular weakness or paralysis.

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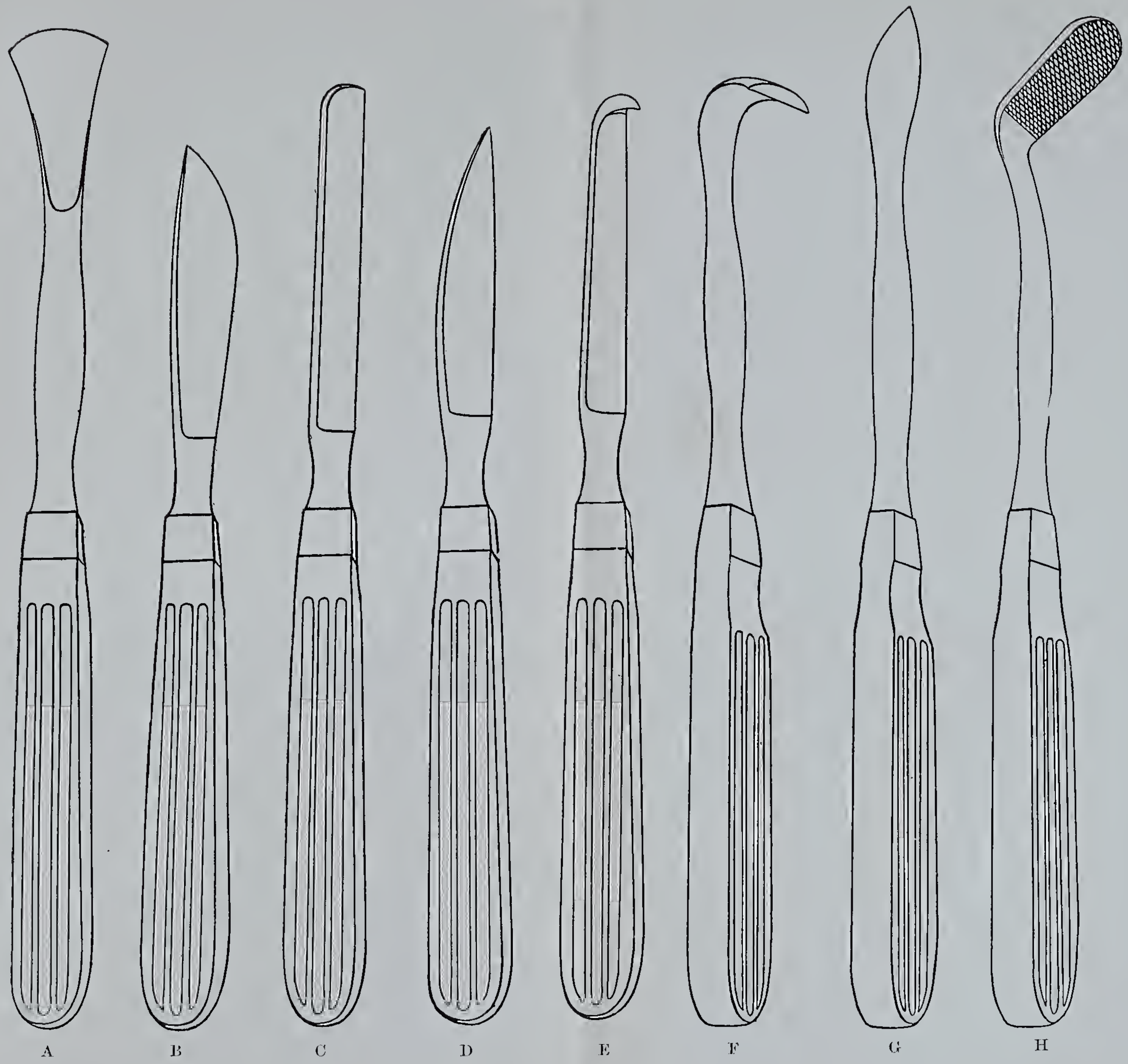
PLATE XII.—INSTRUMENTS USED IN RESECTIONS.

(Langenbeck)



Contra-indications.—Extensive disease of the bones, necessitating so free removal as to render the limb useless or less satisfactory than an artificial one.

Extensive disease of the soft parts unlikely to be greatly bettered by the removal of the diseased joints.

Acute inflammation of the soft parts around the joints.

Enfeebled constitution from any cause, especially visceral disease.

Extreme youth: In very young persons the check to growth of the limb, and tendency to gradual deformity render excision less satisfactory than arthrectomy.

Advanced age: Forty years is as a rule the extreme limit.

Another point to be borne in mind is that excision in cases of joint disease, accompanying general constitutional defects occasionally leads to the lighting up of fresh mischief in other joints or parts of the body. This is especially to be remembered in cases of more or less acute tuberculosis, and in so-called rheumatoid arthritis.

Excision of an anchylosed joint should not be performed where an equally good functional result may be obtained by osteotomy in its near neighbourhood—a less serious operation, and one not interfering with any residual products of prior inflammation. The precautions as to asepsis and hæmostasis cannot be too strongly insisted upon in these operations, as in amputations.

RESECTIONS.

Wrist.

Lister's Method.—Elastic constriction having been first applied to the forearm, any adhesions present are forcibly broken down to facilitate the subsequent steps of the operation. An incision is now made downwards and outwards from the middle of the dorsal aspect of the radius as far as the inner side of the joint between the trapezium and the metacarpal bone of the thumb. Then at an obtuse angle the incision is prolonged vertically downwards along the radial border of the metacarpal bone of the index finger as far as its middle. This incision commences in the angle formed between the extensor communis digitorum and the extensor secundi internodii pollicis. The first portion runs parallel to these tendons and directly across the insertion of the extensor carpi radialis brevior, which will be divided. The angle of the two branches of the incision is close to the insertion of the extensor carpi radialis longior. If the first portion of the incision be carried too far downwards, the radial artery may be divided where it passes over the back of the trapezium and head of metacarpal bone of the thumb.

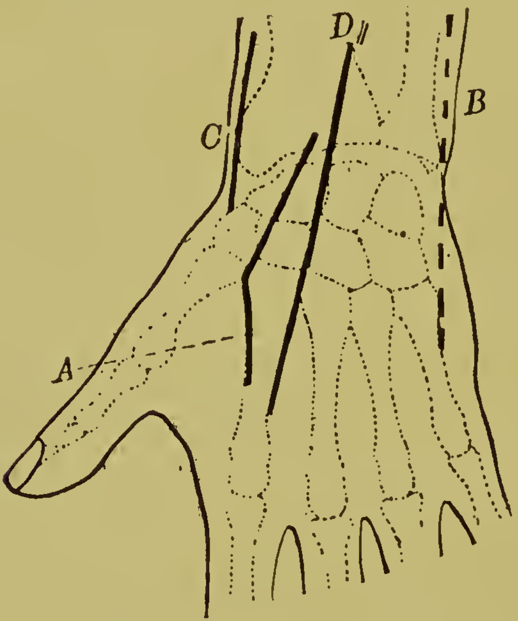
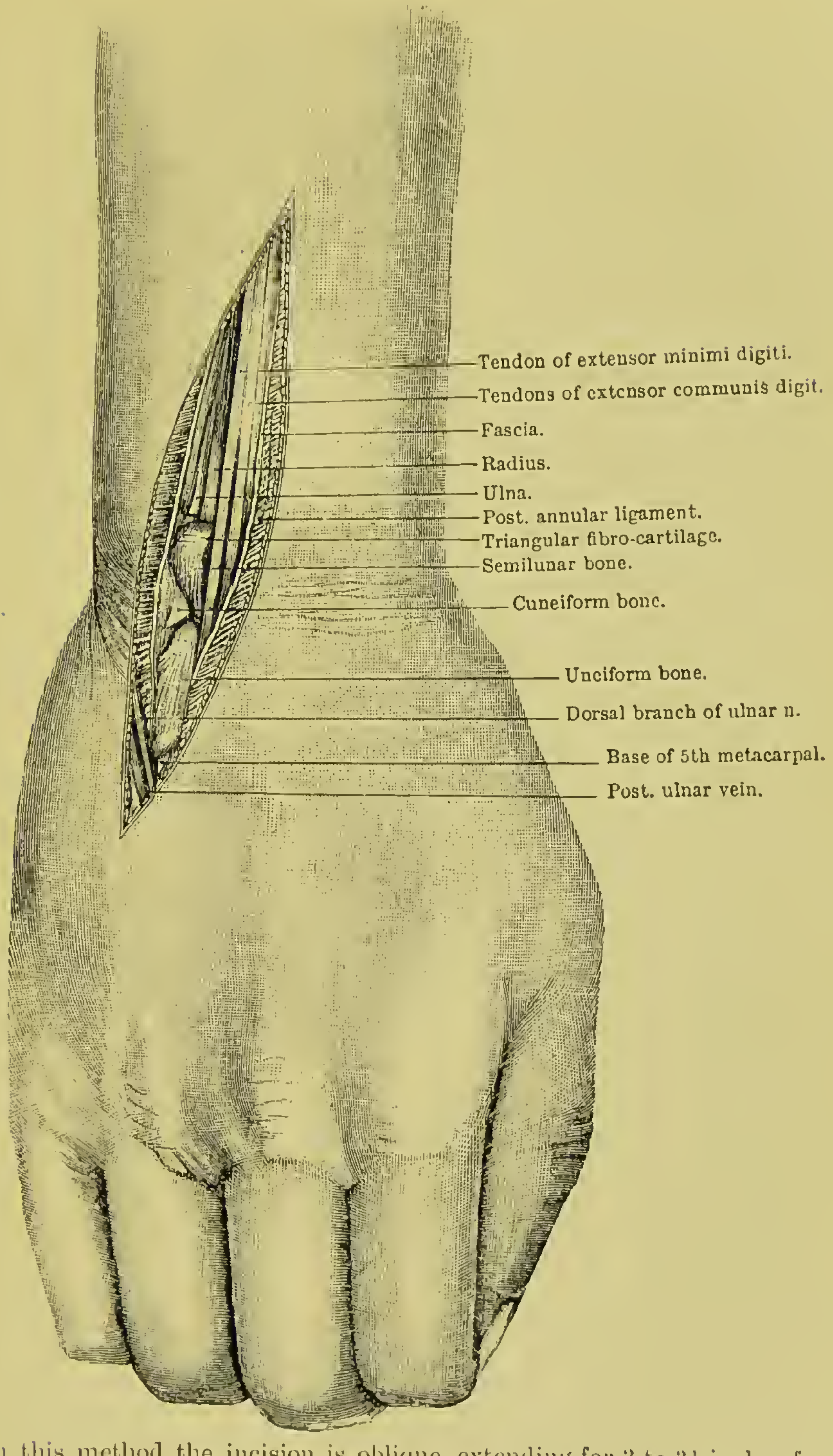


Fig. 28.

A Lister's radial incision.
B Lister's ulnar incision.
C Ollier.
D Langenbeck's incision.

The soft parts are first detached from the bone on the

PLATE XIII.—DORSO-ULNAR INCISION FOR WRIST RESECTION.



In this method the incision is oblique, extending for 3 to 3½ inches from the middle of the dorsal aspect of the fifth metacarpal bone to the centre of the back of the forearm. The radial extensors are protected in this method and permanent flexion of the hand thus avoided. Lister's incision, as in Fig. 28, is more to the ulnar side, while Langenbeck's dorso-radial incision comes exactly over the radial extensors.

radial side of the incision, cutting the extensor carpi radialis longior tendon close to its insertion. Now fully extend the hand and detach the soft parts from the bones on the ulnar side of the incision as far as is practicable, the remaining portion being afterwards separated from the ulnar incision, which should now be made. This should commence rather near the palmar aspect of the ulnar border of the wrist, two inches above the styloid process of the ulna, pass about four inches vertically downwards between the ulna and the tendon of the flexor carpi ulnaris, and terminate over the middle of the palmar aspect of the fifth metacarpal bone. The tendons and the soft parts on the dorsal aspect of the wrist may now be completely separated, the tendon of the extensor carpi ulnaris being cut close to its insertion, as also the dorsal and internal lateral ligaments. The pisiform bone is left connected with the tendon of the flexor carpi ulnaris. The hand being flexed the knife should be carried close to the ulna, so as to avoid injury to the ulnar artery, and through the ulnar incision the flexor tendons are to be separated from the carpus, and the unciform process cut with the bone forceps. The soft parts having been now detached, disarticulate the carpus from the radius, and then by means of the cutting bone forceps, the carpus from the metacarpus. Retract the soft parts on the radial border of the first incision, and with them withdraw the tendon of the secundi internodii and the radial artery out of the way. Detach the trapezium from the trapezoid and scaphoid bones by cutting with the bone forceps in the vertical portion of the incision. No attempt should at this stage be made to remove the former bone, as in doing so the radial artery would probably be divided. The whole carpus is now detached with the exception of the trapezium and pisiform bones, and may be extracted *en bloc*, any remaining connections with the soft parts being separated by a touch of the knife.

The ends of the radius and ulna are readily protruded through the ulnar wound, and a thin slice removed from their articular surfaces with the saw. Saw the ulna obliquely, if possible, so as to preserve the styloid process. This will counteract the after-tendency to displacement of the hand towards the ulnar side. The gouge or sharp spoon may be used if the disease be more extensive.

The extremities of the metacarpal bones must be exposed, and their articular surfaces sawn off with a narrow-bladed saw. The fourth and fifth are most easily reached from the ulnar wound, and the second and third from the radial side. Lastly, if thought advisable to remove it, the trapezium is to be seized in a lion forceps and dissected out, cutting quite close to the bone to avoid wounding the radial artery lying directly on its outer side, or injuring the tendon of the flexor carpi radialis, which is embedded in a groove on its anterior aspect. If diseased, the articular surface of the first metacarpal bone may be also removed, and the pisiform, if implicated may be dissected out, or at least its cartilaginous surface removed.

The tendons which require division are the ulnar and radial extensors of the carpus. These tendons should be cut as long as possible, so that they may form new attachments.

Elbow.

Langenbeck's Operation.—A median incision on the back of the joint, about four inches long, with sub-periosteal raising of the parts, preserves the ulnar nerve and all essential parts from injury. The patient should be placed on the sound side, and the operator can hold the limb conveniently by drawing it across the body.

The longitudinal incision may be made with advantage rather nearer the internal than the external border of the olecranon. It is by far the best form of incision, as it allows of almost perfect preservation of the triceps extensor tendon and its insertion. The ulnar nerve is protected from injury, and the sub-periosteal method can be carried out. The wound may be made at once down to the bone for its entire length; the centre corresponds with the base of the olecranon, above which it should extend for two inches. The triceps tendon is split longitudinally, and the capsule opened posteriorly in a vertical direction. The left fore-finger is now introduced in the wound, its inner margin raised, the inner half of the tendon of the triceps is separated from the olecranon, then the flexor carpi ulnaris and fascia covering it, detached from the ulna, the whole bulk of the soft parts being thus gradually detached from the olecranon, and as far as the internal condyle, by means of the elevator and a strong scalpel, with which short cuts are to be made, the edge being

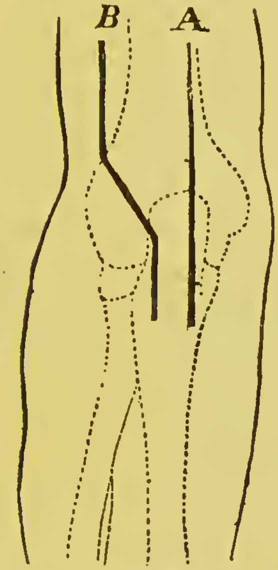


Fig. 29.

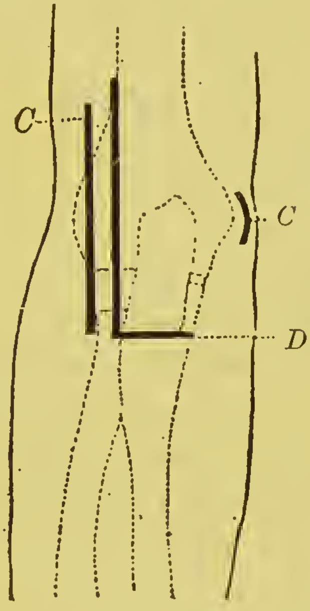


Fig. 30.

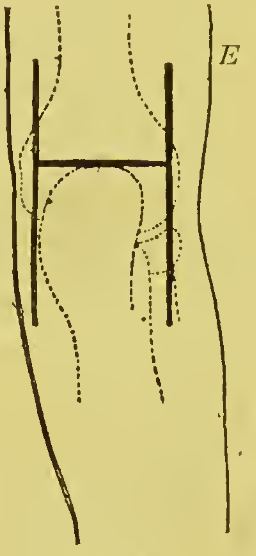


Fig. 31.

A	Langenbeck.
B	Ollier.
C	Hueter.
D	Nélaton.
E	Moreau.

always directed towards the bone; the ulnar nerve should not be exposed, and is in this way safe from injury. When the epicondyle is reached, the muscles inserted in it and the internal lateral ligament are to be detached by cutting close to the bone. Then the soft parts on the outer side of the incision are to be separated from their connections with the olecranon and ulna, partly raising the anconeus where it is inserted on the outer side of the ulna, and detaching the external lateral ligament together with the periosteum. The knife must always cut with short strokes close to the bone, while the soft parts are held well back with retractors and the elevator. If there be no considerable swelling the humerus may be made to project on strongly flexing the joint, and the surface sawn off just below the epicondyles, or the olecranon may be first divided at its base and removed to give more space. Then the bones of the forearm may be made to project, and if the olecranon be already removed, a thin slice removed from the articular surfaces.

It is, perhaps, more essential in the elbow-joint than in any other, in order to secure good results, to preserve the muscular insertions intact in their connection with fascia and periosteum.

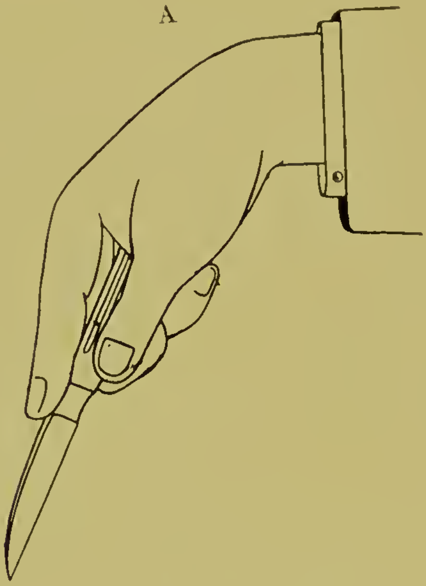
From the epicondyles the muscular insertions must be cut off close to the bone, thus leaving them in connection with the periosteum and internal lateral ligaments.

Only the articular end of the humerus should be cut off, just below or through the condyles. As little as possible should be removed from the bones of the forearm, as otherwise the movement of pronation and supination are materially interfered with.

In traumatic cases the more bone removed, the less likely is a good result to follow. It is important not to remove more than a thin slice of the articular surfaces of the head of the radius and the base of the olecranon.

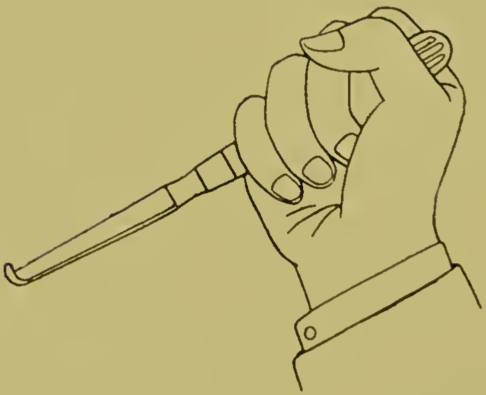
PLATE XIV.—METHOD OF HOLDING SPECIAL KNIVES IN RESECTION OF SHOULDER-JOINT.

A



Entering sharp-pointed knife to begin skin incision.

B



Probe-pointed knife held as in opening shoulder-joint by following bicipital groove.

SHOULDER.

Operation by Anterior Incision.—The patient having been placed on the operating table, and an anæsthetic administered, the arm should rest in the ordinary supine position, with the external condyle pointing directly outwards. In this position the bicipital groove will be directly anterior, and just beneath the line of the wound. Make a vertical incision about four inches long, which should begin above immediately over the acromio-clavicular joint (Fig. 32), divide the skin, subcutaneous tissue, and fibres of the deltoid muscle down to the capsule of the joint. This incision will expose the biceps tendon in the bicipital groove, which will at once be recognised when the margins of the wound are drawn asunder.

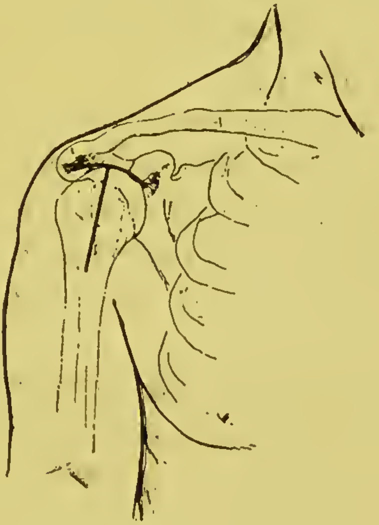


Fig. 32.—Langenbeck.

When the head, together with the tuberosities, as is usually the case, require removal, cut down to the bone along the internal margin of the bicipital groove, and divide the periosteum vertically; continue this incision upwards into the joint, and divide the capsule thoroughly with a probe-pointed knife, cutting from within upwards and outwards; then elevate the periosteum and soft parts on the inner side by pressing the elevator inwards below the lesser tuberosity, while the arm is being gradually rotated outwards by an assistant. From the tuberosity itself the attachment of the muscle must be divided with a scalpel by cutting close to the bone, so that it may preserve its connection with the periosteum on one side, and the joint capsule on the other. By continuing to rotate outwards the axillary surface is reached, and the capsule thoroughly separated on this aspect. Then the arm should be replaced in the first position, the biceps tendon, when present, lifted from its groove and displaced inwards. An incision is now to be made along the outer border of the bicipital groove, the periosteum and muscles raised by means of the scalpel and elevator, in the manner before described, from the greater tuberosity; the head may now be turned out and sawn off.

This method of operation possesses some disadvantages as well as advantages. The deltoid is divided where its integrity in regard of subsequent functions may be important. When the incision extends low down, the cutaneous branches of the circumflex nerve may be divided where they are still of large size.

The incision being anterior the drainage is imperfect; but a drainage-tube may be passed out behind from the deepest part of the wound, through a buttonhole opening made at the border of the latissimus dorsi muscle. Indeed, it is advisable in most cases to have a counter-opening.

Operation by Posterior Incision.—If the bone do not require to be divided below the tuberosities, these disadvantages may be avoided by having the incision for its removal on the posterior aspect of the joint. The patient must be placed on the sound side, the arm flexed at the elbow, somewhat abducted and rotated outwards, so that the external condyle looks backwards. This brings the middle of the great tuberosity into the line of the wound. A vertical incision is then made downwards for about four inches from the prominent angular projection so plainly felt on the inferior margin of the acromion.

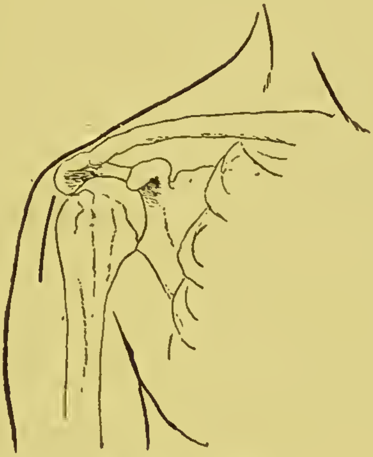


Fig. 33.—Whyte.

The posterior part of the deltoid is divided, and the knife sunk at once into the capsule beneath the acromion. The great tuberosity and the bicipital groove just in front of it may now be brought within the area of the wound, and the muscles attached to the tuberosity can be separated.

The rotation outwards of the arm being continued, the elevator is used to raise the periosteum and capsule till the bicipital groove is reached, when the biceps tendon is dislodged. Then the arm must be strongly rotated inwards, and the subscapularis muscle at its insertion will come into view; this is separated in a similar manner from the lesser tuberosity. The head may now be made to project from the the wound, and by rotating alternately outwards or inwards any remaining soft parts or capsule may be divided on the anterior and axillary margins of the wound, the head fully luxated and removed.

The figures here introduced show the other methods of reaching the shoulder-joint; but in all cases where there is any danger that amputation might be necessary, the anterior incision is best.

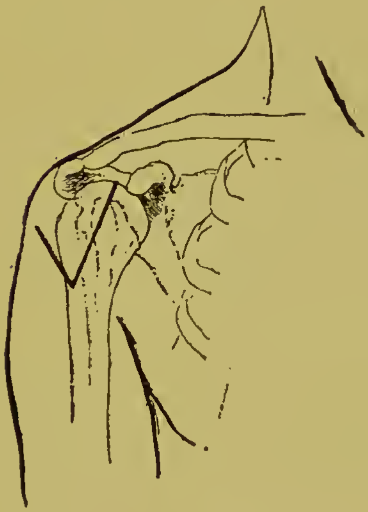


Fig. 34.—Syme.

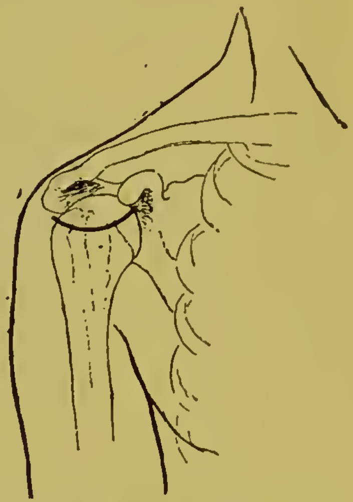


Fig. 35.—Nélaton.

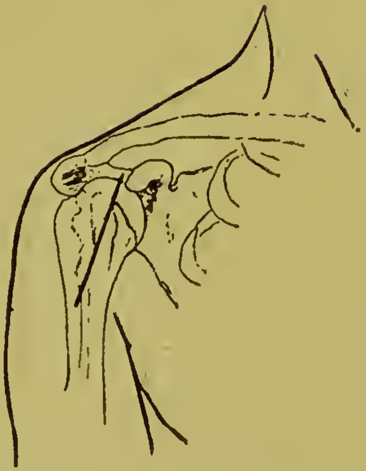


Fig. 36.—Malgaigne.

RESECTION OF TARSUS.

ANKLE.

Mikulicz's Operation.—The patient must be placed in the prone position. If it be the right foot the knife is introduced on the inner border of the foot; just in front of the scaphoid tubercle, and a transverse incision extending to the bone is made across the sole of the foot a little behind the tuberosity of the fifth metatarsal bone. For the left foot the direction of this incision will be reversed.

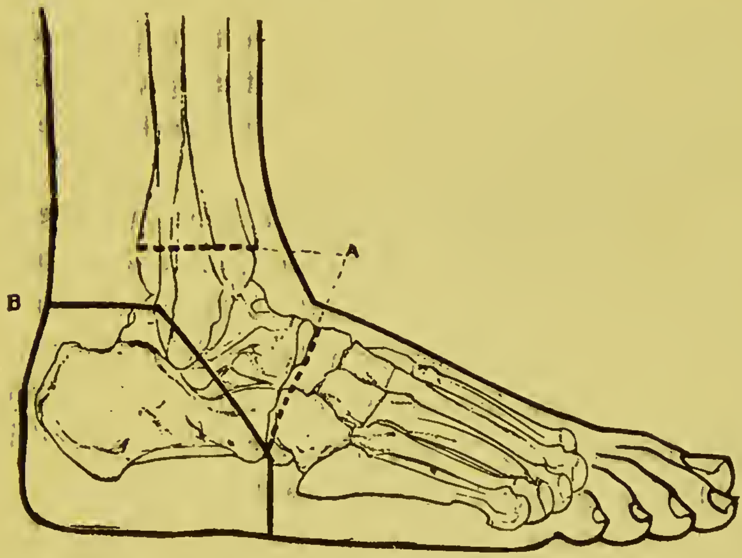


Fig. 37.
(Mikulicz).

From the inner and outer extremities of the wound, an incision is to be prolonged obliquely upwards and backwards over the corresponding malleolus, and the extremities of these incisions united by a transverse cut across the back of the leg (Fig. 37), made down to the bone at the level at which it is to be sawn, which will usually be just above the line of the joint surface of the tibia. In some cases a larger removal of the bones of the leg has been practised, and then, of course, the lateral incisions will be more oblique and the posterior transverse cut made at a higher level. The ankle-joint is now opened from behind and disarticulation effected. The foot being dorsally flexed the soft parts are carefully separated from each other in front until the medio-tarsal joint is reached, at which disarticulation is accomplished, as in Chopart's operation. The posterior portion of the foot, consisting of the astragalus, calcis, and soft parts covering the heel, is then removed; and the malleoli and articular surface of the tibia sawn off from behind forwards. The joint surfaces of the cuboid and scaphoid bones are then removed in the same direction; or, if preferred, the bones may be sawn through without any previous disarticulation after the soft parts have been separated to the needful extent.

The anterior portion of the foot remains connected with the leg by a bridge of skin three to four inches wide, together with the extensor tendons in front of the ankle-joint. It derives its blood supply from the anterior tibial artery, which appears to be ample, for very shortly after the amputation the blood issues freely in jets from the distal extremities of the divided internal and external plantar arteries. As soon as the hæmorrhage is arrested, the cut surfaces of the scaphoid and cuboid bones are applied to those of the tibia and fibula, and should be sutured there to prevent shifting. The remainder of the foot is thus brought into a straight line with the leg, and bony union, with an excellent useful stump, is the final result. A posterior as well as an anterior splint should be applied to secure the parts in good apposition, and in order to maintain the toes in a state of complete dorsal flexion, or at right angles with the foot.

Langenbeck's manner of excising the ankle is admirable. It may be described as follows:—Turn the foot on its inner side, and rest it on a firm cushion. Make a vertical incision three inches in length along the anterior border of the fibula to the tip of the malleolus (Fig. 38). This may with advantage be continued so as to return for an inch upwards along the posterior border of the bone, and it may be continued for one-third of an inch beyond the tip of the malleolus if care be taken to avoid injury to the peroneal tendons. The periosteum and soft parts are now detached from the bone, often a difficult and tedious business, and the fibula may then be removed by sawing it through somewhat obliquely from above downwards, an inch above its extremity; the divided end is seized in the lion forceps, or held outwards by a sharp hook inserted in the bone, while the deeper connections. especially the interosseous tibio-fibular ligament, are detached by the elevator and knife—the most tedious part of the operation. The latter structure should be preserved in traumatic cases on account of its active osteogenetic power. The ligaments are thus preserved in connection with the periosteum, and the sheaths of the tendons are not opened. Next, the upper surface of the astragalus is to be removed

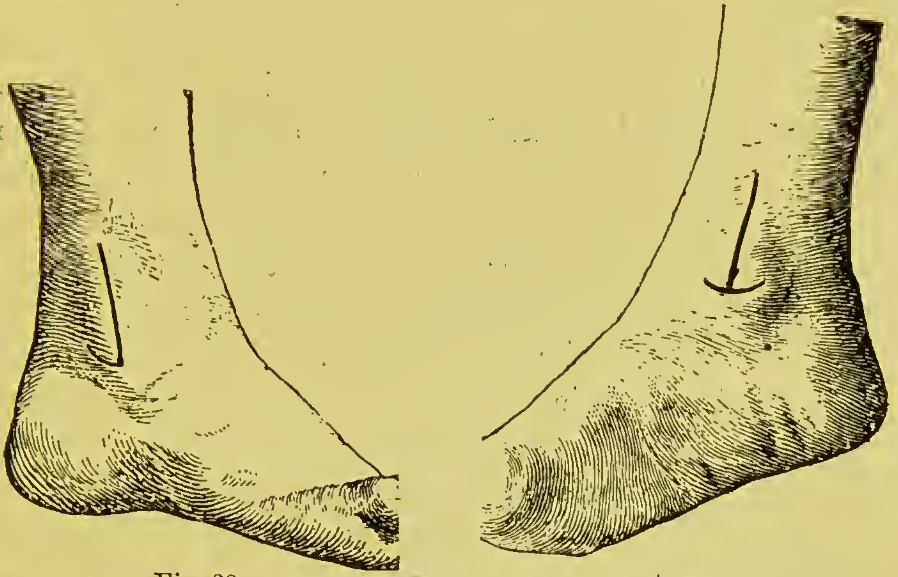


Fig. 38. Fig. 39.

(Langenbeck's Resection of Ankle).

with a key-hole saw. This is most easily done at this stage of the operation, before the parts are rendered loose and movable by further dissection; if required, even the whole bone can be removed. Many, however, prefer to make the internal incision before removing the astragalus or sawing off its upper surface. The foot in that case is to be placed on its outer side, and an incision made two or three inches in length, along the centre of the inner surface of the tibia, terminating at the tip of the internal malleolus (Fig. 39). All the tissues should be at once divided down to the bone, the periosteum inclusive. It is advantageous, in order to give greater space, to make a semicircular incision close around the end of the malleolus, but dividing only the skin and subcutaneous tissue. The periosteum and soft parts are now to be detached from the bone, which is more easily done than in the case of the fibula, and when laid bare by division of any still uncut portions of the tissue, especially the ligaments attached to the malleolus (the knife being made to cut close to and perpendicular to the bone), the end of the tibia may be projected through the incision, and the determined amount of the bone sawn off. In traumatic cases this will be limited,

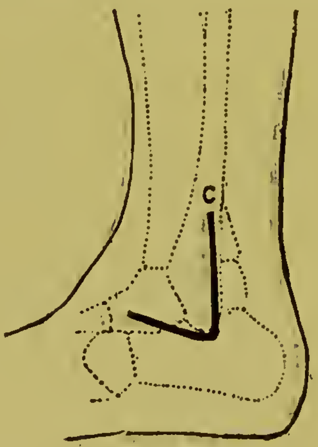
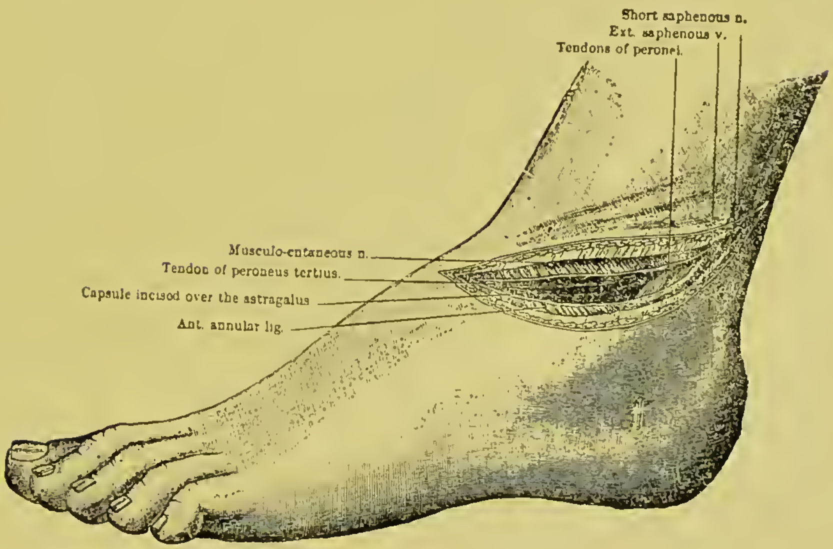


Fig. 40.

Stimson's excision.

PLATE XV.—RESECTION OF THE ANKLE JOINT.



(Reverdin).

The incision here shown is the one recommended by Köcher and Reverdin when the disease is limited. In this operation all the tendons and soft tissues surrounding the joint are preserved. Complete luxation is brought about before any attempt is made to remove the bone ends.

and on a level with the insertion of the capsule. The articular surface of the astragalus can be now removed with the key-hole saw. Although difficult to avoid opening the sheath it is important not to do so, and expose the tendon of the tibialis posticus muscle, nor indeed any of the tendons.

KNEE.

The operator selects a large scalpel, and makes with it an incision convex downwards from side to side across the front of the joint. The incision should commence and terminate on each side at the posterior margins of the condyles of the femur, and at the lowest part in front correspond to the insertion of the tendo-patellæ. After the skin and subcutaneous tissues are divided the knee should be bent a little, and a second sweep of the knife will divide the tendinous insertions of the patella and the capsule, fully exposing the joint. The anterior flap can then be detached and thrown back, exposing the deep surface of the patella. The articulation should now be completely flexed by the assistant while the operator divides in succession first the lateral, then the crucial, and the attachments of the posterior ligaments.

The condyles of the femur, which should be first removed, will now readily project from the wound, and the knife is drawn around them, along the line of application of the saw, to detach any still adhering soft parts; the articular surface is sawn off in a direction at right angles to the long axis of the shaft, keeping strictly parallel to the plane of the free surface of the condyles. It is a matter of indifference from which side the bone is sawn, as the femoral artery is separated from the posterior surface of the femur by a considerable interval filled with the fat.

The tibia being now pushed vertically up, and held forward by the assistant placing his left hand high up behind the leg and placing his right hand under to support it, the

INCISIONS FOR RESECTIONS OF KNEE.

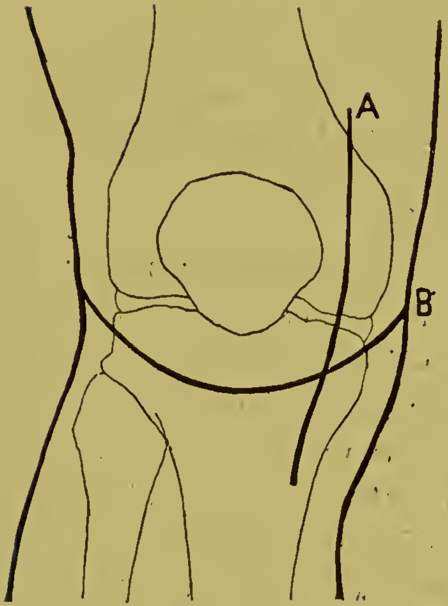


Fig. 41.

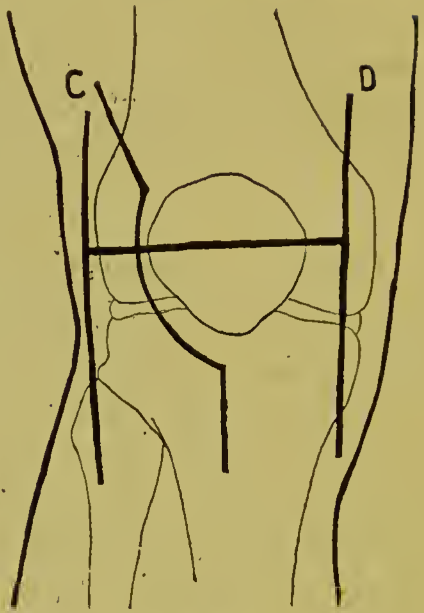


Fig. 42.

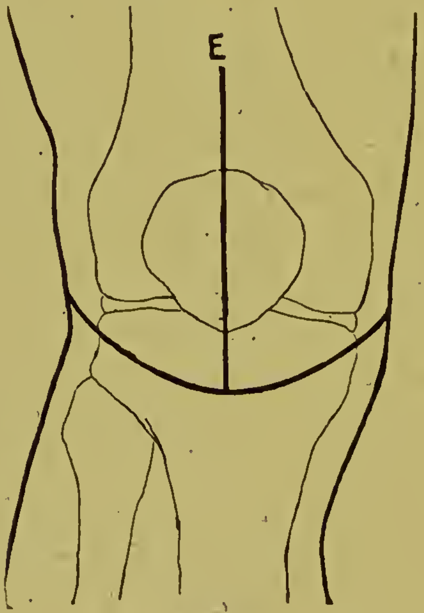
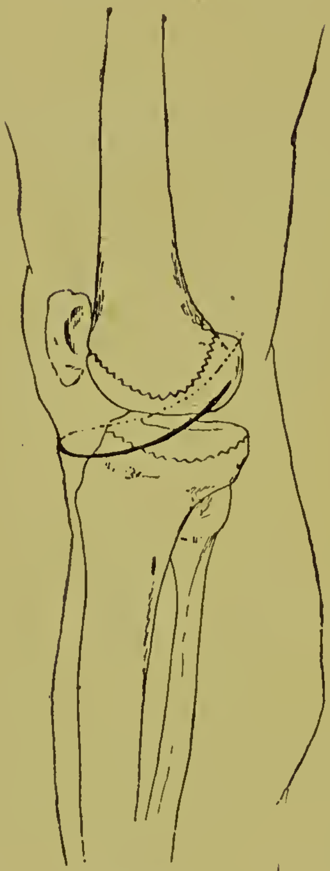


Fig. 43.

A	Langenbeck.
B	Mackenzie.
C	Ollier.
D	Moreau.
E	Tobin.

PLATE XVI.—RESECTION OF KNEE.



(Köcher).

This Plate shows the line of incision going well back to the posterior edge of the condyles, and it also shows the lines of section of the bones advocated by Metzger, a convex surface being left on femur to fit into the concavity left by section of the tibia. A reference to Figs. 44 and 45 will show that by sawing the bones thus the epiphyseal cartilages are avoided, and the subsequent growth of the bones is not interfered with.

knife is passed close round the articular margin of the bone to make a groove for the application of the saw, and a thin slice of the tibia removed by sawing from before backwards, taking care that the cut section shall be exactly parallel with the plane of the articular surface of the bone and that the soft parts behind are protected from injury.

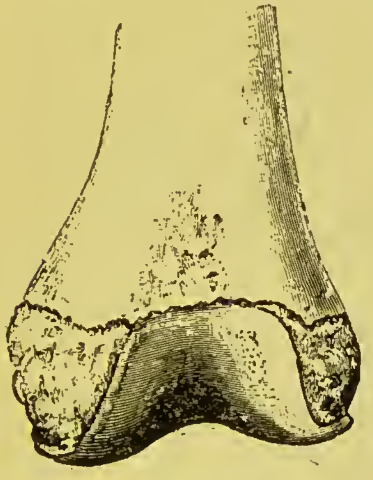


Fig. 44.

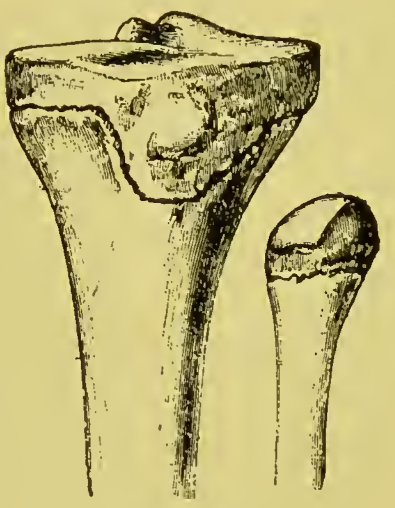


Fig. 45.

Fig. 44.—Epiphyseal line of femur.
Fig. 45.—Epiphyseal line of tibia and fibula.

The neighbourhood of these lines must be avoided, as the irritation of sawing may cause rapid ossification or absorption, so that growth may be checked as effectually as if the cartilage were removed.

HIP.

Langenbeck's Method.—The patient is placed on the opposite or sound side, the limb flexed nearly to an angle of 45°, and slightly rotated inwards. An incision is then made in the long axis of the femur over the outer side of the trochanter major, similar to the incision made over the olecranon for excision of the elbow. It should run a little behind the middle of the great trochanter and correspond with a line directed towards the posterior superior iliac spine.

Two-thirds or nearly, of the length of the wound, which is about four and a half inches long, lies over the ilium above the trochanter, and the remaining third upon the trochanter and femur. The situation of the great sciatic notch must be carefully made out beforehand, so that the incision which runs near to its upper margin, may not implicate it.

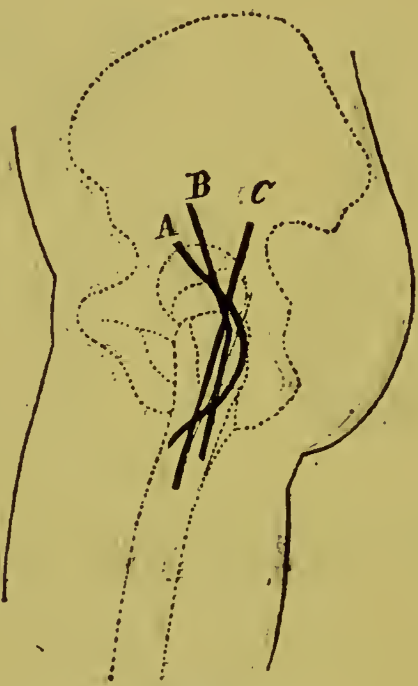


Fig. 46.

A Sayer.
B Ollier.
C Langenbeck.

It is important to go at once down to the bone and capsule of the joint with one cut. The wound, if necessary, may subsequently be enlarged by cutting from within outwards and upwards with a probe-pointed knife. The gluteal muscles are thus easily and evenly divided, and the capsule and upper external margin of the acetabulum laid bare.

The capsule is now opened in the direction of the external wound, and the ligamentous tissue transversely divided on each side close to its insertion into the acetabulum. Air will then enter the previously air-tight joint. The index finger of the left hand is now introduced into the wound and incision in the capsule, and the latter is hooked forward and further divided, as well as the muscles inserted into the trochanter major close to their attachments, first on the anterior margin of the wound and then the posterior margin. The knife is to be kept as close as possible to the bone, the limb being first gradually rotated outwards, while, during the division of the muscles on the posterior margin of the wound, the limb is rotated inwards. If the round ligament still exist, it must now be cut through, the limb being moderately rotated inwards, abducted and flexed; a narrow strong knife is introduced at the posterior border of the acetabulum and the ligament divided from above downwards. These remarks apply rather to traumatic cases, as in disease the ligamentum teres no longer exists. The head may now be dislocated and sawn off, or the neck may be divided with a keyhole saw, without previous dislocation, and the head and neck removed afterwards. When the disease is extensive the great trochanter, together with the head and neck, should be removed.

When the operation is done sub-periosteally, the muscles and periosteum must be detached successively from the trochanter on each side of the wound with the knife and elevator. This can be done in children and in case of secondary resection after injury, but it is impracticable where excision is performed for recent injury in the adult. The periosteum should be preserved in the absence of tubercle, but these, of course, will form a minority of its cases, not merely on account of its osteogenetic properties, but because the tendinous insertions into it are thus preserved and the result is better. The insertions of the gluteal muscles remain connected with the periosteum and with each other, while the insertions of the small rotators are also preserved.

Deep retractors should be inserted on each side after the first incision has been made, and the margins of the wound held apart; the division of the capsule and the rotator muscles is thereby much facilitated.

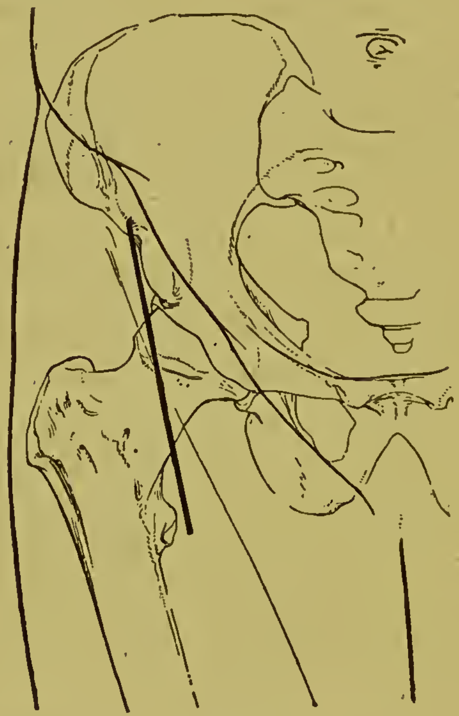


Fig. 47.

Lücke's straight anterior incision (Fig. 47) may be adopted when removal of the head of the femur would suffice and where drainage is unnecessary.

There is much difference of opinion as to whether it is desirable in all cases to remove the trochanter. Contrary to expectation, the removal of the parts, by cutting below the trochanter, does not seem to give a worse functional result than simple decapitation. A new head or a head-shaped excrescence, which takes the place of the amputated one, is usually formed.

Sayre urges that the great trochanter should always be removed, because it interferes with effective drainage from the deep part of the wound, and locks up the secretions like a cork in the mouth of a bottle, and statistics appear to verify this assertion.

In Germany, the neck is generally sawn through first, and the trochanter subsequently removed, only if it be found diseased. Langenbeck thinks that where the condition admits of it, only the head and neck of the femur should be excised, and that as good a result is obtained as when the great trochanter is also removed.

If the head only requires excision, the periosteum and capsule may be elevated from the neck, and the bone divided with a key-hole saw.

UPPER JAW.

Ferguson's Operation.—The patient is arranged at a convenient height, with the head and shoulders raised, the surgeon standing on the same side as the jaw to be removed, and his chief assistant opposite. The central incisor tooth of the corresponding side is drawn, and the incision is then commenced by splitting the upper lip into the nostril; the vessels in this, especially the superior coronary and the artery to the columella, are clamped, and the upper lip is then separated from the bone by division of the mucous membrane and central attachment of the orbicularis oris. The incision is now prolonged around the ala of the nose, up its side to half an inch below the inner canthus, and carried, with a slight curve following the line of the lower margin of the orbit, to the outer limit of eye (Fig. 48), or, if necessary, onwards to the zygoma. The large flap thus marked out is then raised from the bone as rapidly as possible—all bleeding points being taken up as the vessels are divided—an assistant meanwhile compressing the facial artery, so as to minimise the loss of blood. In the dissection of this flap

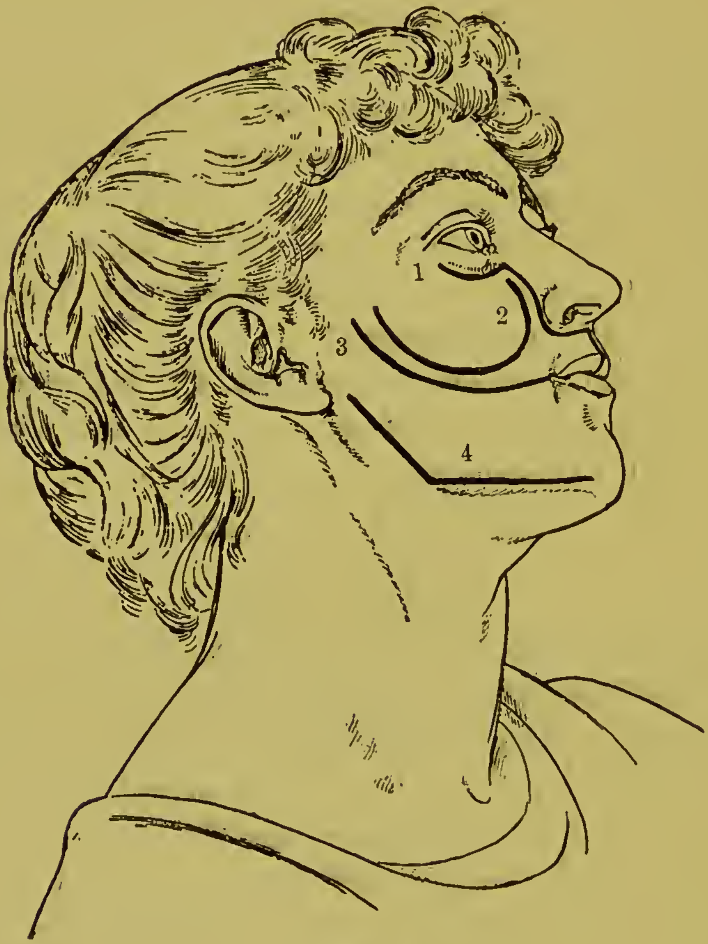


Fig. 48.

1 Ferguson's.
2 Langenbeck's.
3 Velpean's.
4 Excision of lower jaw.

the origins of the following muscles need to be separated :—Orbicularis oris, depressor alæ nasi, compressor naris, levator anguli oris, levatores labii superioris proprius, et alæque nasi, orbicularis palpebrarum, masseter, external and the small head of the internal pterygoids. The trunk of the facial artery and a number of small branches are divided, also the terminations of the infra-orbital and transverse facial vessels. The infra-orbital nerve at its exit from the foramen and numerous small branches of the fifth and seventh nerves are cut.

When the flap is sufficiently reflected, and all hæmorrhage from its deep surface controlled, the nose is separated from the margin of the anterior nares, and the periosteum is divided along the margin of the orbit, so as to allow the elevation of the eye and orbital muscles with as little disarrangement as possible. In this latter procedure the inferior oblique muscle of the eye is separated from its origin. In cases of extensive malignant disease the periosteum must be sacrificed—a considerable disadvantage. A pair of bone-forceps, or the key-hole saw is now made to cut through the nasal process from the anterior nares, and the malar bone is in like manner sawn through, the cut extending into the spheno-maxillary fissure. Prior to sawing the palate, the mucous membrane of the mouth is divided longitudinally, and, the saw being introduced by the nostril, the section is rapidly made.

The bone, now freed from all but its posterior and upper lateral connection, is seized with a lion forceps and twisted out. If the soft palate be not implicated, a preliminary incision along the posterior margin of the hard palate should be made, as the horizontal plate of the palate usually comes away with the jaw-bone.

LOWER JAW.

Operation.—The central incisor tooth on the side to be removed needs to be extracted. An incision is commenced just beyond the most prominent part of the chin, and carried backward to the angle, the knife is carried at once down to the bone dividing the skin fascia and platysma muscle, and the trunk of the facial artery, which is at once ligatured. The latter may, if preferred, be bared only by the incision and doubly ligatured before division. The incision is further prolonged around the angle and upwards along the posterior border of the vertical portion of the bone, as high as the lower border of the external auditory meatus. The incision should never rise above this point, lest the transverse facial artery and the branches of the seventh nerve supplying the muscles around the eye and the cheek should be injured.

The soft parts are now separated from the outer surface of the bone; the levator menti, depressor labii inferioris, depressor anguli oris, buccinator, and masseter muscles need to be raised, and in the case of simple growth or necrosis they should be lifted with the periosteum. This being done an elevator is insinuated behind the bone at the point where the incisor tooth has been previously extracted, and held there as a guard while the bone is sawn through. The distal end of the opposite inferior dental artery sometimes needs plugging. The cut end of the part to be removed is now best grasped with a sharp hook, and held outwards while the soft parts are rapidly separated from the inner aspect of the bone. The mucous membrane needs division, the sub-maxillary and sub-lingual glands must be pushed away, and the following muscles are freed from their attachments—genio-hyo-glossus, genio-hyoid, digastric, mylo-hyoid, superior constrictor, and internal pterygoid. As in the case of the outer surface the periosteum should be saved if possible. The inferior dental artery and nerve are divided; also the pterygo-maxillary, stylo-maxillary, and internal lateral ligaments. The cut end of the bone is now forcibly depressed, and the insertion of the temporal muscle separated from the anterior border of the vertical ramus and from the coronoid process; if this part of the operation be difficult, it may be simplified by cutting the coronoid process off, which if needful can be removed later. The jaw is now free except for its condyloid attachments; these are divided on their outer aspects, and the bone is forcibly twisted, while with light touches of the knife the insertions of the external pterygoid muscle and the circumference of the joint capsule are successively divided, care being taken not to pass the knife behind the condyle and endanger the internal maxillary artery.

Resection of the Ramus and half the Body.—An incision is begun close to the posterior border of the ramus on a level with the lobule of the ear, carried down to the angle of the jaw, and thence along its lower border to the symphysis, where it is met, if necessary, by a vertical one, beginning below the free border of the lip a little to that side of the median line on which the bone is to be removed. The flap thus marked out is dissected up from the bone as far as can be done without opening into the buccal cavity, and the divided facial artery tied. The inner surface of the bone is then cleared in the same manner, an incisor tooth drawn, and the bone sawn through. The jaw is then drawn downwards and forwards, the denudation of its inner surface completed by dividing the attachment of the mucous membrane and of the internal pterygoid, and the inferior dental nerve cut squarely across at the point where it enters the bone.

The insertion of the temporal muscle upon the coronoid process is divided with curved scissors while the jaw is forcibly depressed, or the process itself is cut through if it is so long that its extremity can not be reached. The remaining soft parts are carefully detached upwards towards the condyle, the knife, or better, the elevator or the handle of the scalpel, being kept close to the bone, and the separation completed by twisting the jaw out.

SPECIAL OPERATIONS.

NEPHRECTOMY.

LINES OF INCISION FOR NEPHRECTOMY.

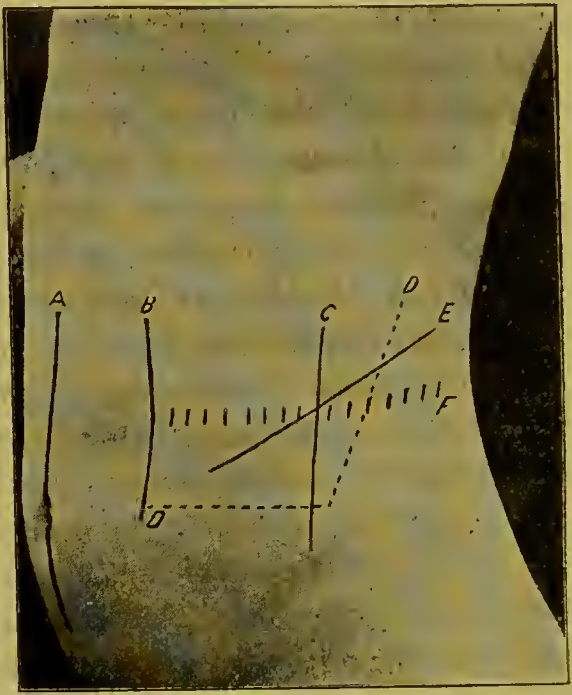


Fig. 49.

A Linea alba.
B Linea semilunaris.—Thornton.
C Costo-iliac.
D Lumbo-abdominal flap.—König.
E Sub-costal oblique.—Kümel.
F Lumbo-abdominal, transverse.—Abbe.

Lumbar.

An oblique incision is made from the edge of the erector spinæ below the last rib downwards and forwards, towards the crest of the ilium (E, Fig. 49); the length depending on the size of the tumour to be removed. The skin, fascia, fatty tissue, the external oblique, and latissimus dorsi muscles are cut through to the full extent of the skin wound, the internal oblique and lumbar fascia are thus exposed. These with the outer border of the quadrates lumborum are now divided out; the fascia covering the peri-renal area is thus exposed. Opening this the fatty tissue around the kidney can be readily detached by means of the index finger of one hand introduced into the depths of the wound and swept round the organ in close contact with its capsule. In this manner the gland is isolated.

When there has been much inflammation, the tissue surrounding the kidney will be found condensed and adherent, and the enucleation of the organ will then be difficult or impossible. In such cases the kidney should be enucleated from its thickened and firmly-adherent capsule, and the latter left behind with the pedicle. In effecting this enucleation, a flat hernia director, or a round-pointed periosteal elevator, will be found to be of service. The only guide in such enucleation is the exposed kidney tissue itself.

ABDOMINAL NEPHRECTOMY.

Langenbeck's Operation.—A vertical incision is made in the semi-lunar line (B, Fig. 49), about four inches in length, and is commenced just below the margin of the ribs. The abdomen is opened, and when all bleeding has been checked the hand is introduced, passed across to the opposite side of the body, and the opposite kidney carefully examined. The small intestines are kept aside by means of a large flat sponge, which is introduced into the abdomen. The colon is pushed towards the median line. The surgeon then incises the outer layer of the meso-colon vertically over the renal region. Into the rent thus made the fingers are introduced and the kidney is laid bare. If the parts around the gland are in a fairly healthy condition, it is well at once to clear the pedicle and to ligature the vessels. When this has been done the enucleation of the kidney becomes an almost bloodless procedure. The vessels are reached by stripping off the peritoneum in the direction of the aorta. They may be tied in two segments, the ligatures being passed on an aneurism needle through the centre of the vascular part of the pedicle. The vessels on the renal side of the ligatures are secured by pressure forceps applied close to the kidney, and between the forceps and the ligatures the vessels are divided with blunt-pointed scissors. Nothing now attaches the kidney but the ureter.

Methods of dealing with ureter:—

1. Ligature and dropping stump into abdomen after section.
2. Ligature and fixing in lower angle of wound.
3. Snipping out mucous membrane; suturing muscular coat over mouth after disinfection and then dropping.
4. Cauterising stump and dropping.

2 and 3 are most reliable.

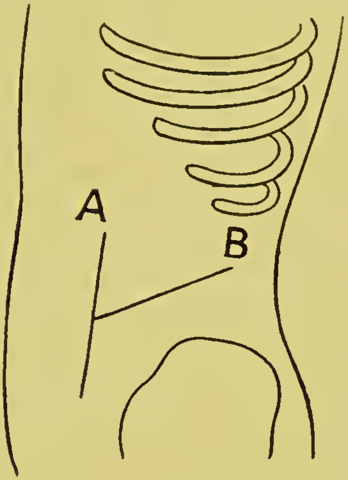
NEPHRORRHAPHY.

The suturing of the kidney to the abdominal wall, either for the relief of floating kidney, or for the purpose of keeping it in position during drainage, is readily carried out through the sub-costal oblique incision of Kümel, as shown at (E, Fig. 49). The only point of importance to be noted in reference to this suturing, is that the sutures must not be passed deeply into the renal substance. They must not be too numerous, and they should be of some such material as silk-worm gut.

NEPHROLITHOTOMY.

The removal of a stone from the kidney can be conducted through the same incision as in the preceding operation. Section of the kidney should be made unless otherwise contra-indicated in that line which will allow freest drainage during the healing of the kidney wound.

PLATE XVII.—ABDOMINO-LUMBAR NEPHRECTOMY.



M'Ardle.

Steps of abdomino-lumbar nephrectomy:—

1. Incision in semi-lunar line through entire abdominal wall.
2. Exploration of opposite loin.
3. Detachment of peritoneum along outer lip of incision and closure of peritoneal cavity by suturing to inner lip by continuous suture.
4. The index finger is passed backwards and upwards from the middle of the incision between the peritoneum and transversalis fascia until it reaches the peri-renal tissues, where with stout scissors the abdominal wall is cut through in the line indicated in the above drawing.
5. The triangular flaps, A and B, are now transfixed by strong silk and drawn outwards, while the peritoneum is gently pushed inwards with soft sponges.
6. A large well curved needle, armed with stout silk, is now passed round the vessels and double ligature section carried out.
7. The hand is then passed round the kidney above, detaching it from its capsule, unless in cases of malignant character. Freeing it now on the outer side and below the organ is left attached only by the ureter.
8. The ureter is double ligatured and sponges placed under it, and section between the ligatures frees it entirely.

It must be remembered that after all operations of this class on the kidney, provision should be made for thorough drainage of the lumbar wound.

OPERATIONS ON THE BLADDER.

It is well, before starting the operative surgery of the bladder, to fix firmly in our minds the exact position of the fixed portion of that organ, namely, the prostatic area. The diagrams in most of the surgical text-books are very misleading, as they place the vesical opening of the urethra deep down behind the pubes, whereas a reference to the accompanying photograph of a frozen section will show that it approaches very nearly the upper level of that bone. So that instead of the examining finger (in the operation for prostatectomy) having to dip down towards the perineum, it has only to pass backwards towards the rectum.

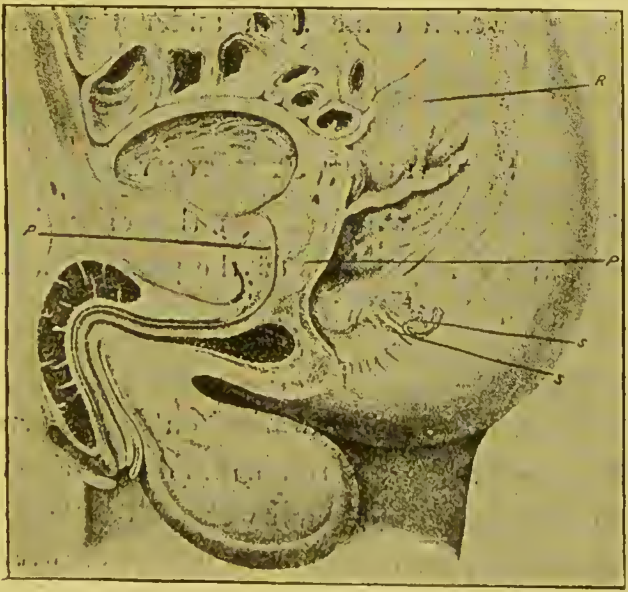


Fig. 50.

P P	Prostate.
R	Rectum.
S S	Sphincters.

Another point of equal importance, from a surgical standpoint, is the possibility of arresting hæmorrhage from the lower segment of the bladder by pressure. When irrigation fails to arrest bleeding, long strips of iodoform gauze may be pressed well into the prostatic area, while the urine can be drained through the supra-pubic wound. The influence of change of position, as an aid in operations on the bladder, conducted through the abdominal wall, must not be overlooked. Raising the patient on a Trendelenberg's table, relieves the bladder from intestinal pressure, and thus allows it to distend more readily prior to operation, and allows better illumination of the wound during the subsequent steps of the proceeding.

Another point of some importance is that anæsthesia should be profound, as nothing interferes more with the removal of stone or tumour, or the final suturing of the bladder wall, than the contraction of the recti muscles, when the patient is allowed to come from under the influence of the anæsthetic.

SUPRAPUBIC CYSTOTOMY.

This operation is conducted for the removal of calculi, tumours, and enlargements of the prostate, and may be carried out in the following manner.

Preparatory steps :—

The bladder being well washed out with warm boracic solution, the catheter is retained, and Petersen's rectal balloon passed into the bowel well above the sphincters, and then distended with 8 or 10 ounces of warm water. The distension of the bladder now with 12 to 14 ounces of boracic solution will raise the peritoneum as far above the pubes as possible, and cause that viscus to be felt as a rounded mass.

Incision :—

Three inches in length immediately above pubes (Fig. 51). This is carried down through the cellulo fatty tissue which overlies the bladder in these situations, great care being taken to avoid the post-pubic veins, which show prominently in the wound. No tearing with the fingers is allowable, as such manipulations lead to delay in healing and to extravasation in the post-pubic cellular tissues.

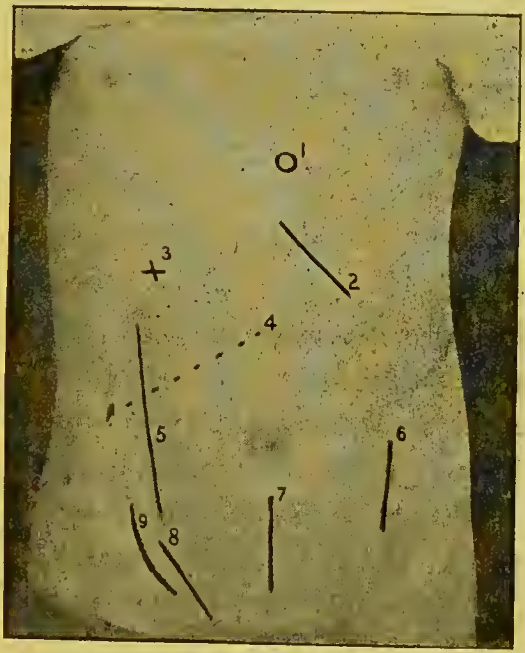


Fig. 51.

1. Level of cardiac orifice.
2. Gastrostomy.
3. Gall-bladder.
4. Billroth's pylorectomy.
5. Nephrectomy, abdominal.
6. Abdominal colotomy.
7. Ovariotomy.
8. Radical cure of inguinal hernia.
9. Ligature of external iliac.

Opening the bladder :—

A tenaculum is passed into the upper part of that organ, taking care that the peritoneum is above the hook. A sharp scalpel is then passed into the bladder, cutting vertically towards pubes. As it enters the bladder the contained fluid rushes into the wound. The incision is continued to an extent sufficient to readily admit the index finger. The edges of the wound are now secured by forceps as in (Fig. 52). The separation of these allow easy introduction of the finger and they prevent retraction of the bladder behind pubes, when the tenaculum is removed. Clip forceps should not be employed, as they contuse the delicate tissues of the bladder.

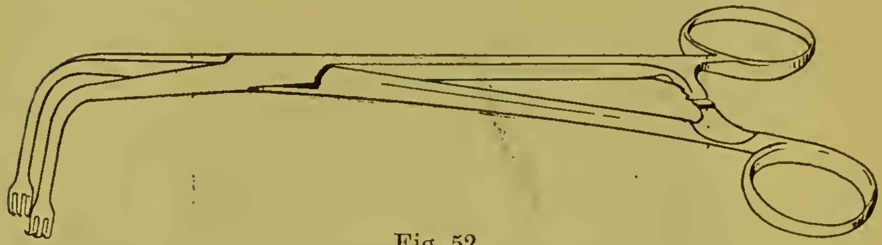


Fig. 52.

Lithotomy :—

If the object is the removal of a stone, the finger is passed into the bladder, the size of the stone ascertained, and a proper forceps, guided by the finger, grasps the stone which is removed by gentle traction. If the calculus be encysted, it may be necessary to remove the rectal bag, in order to obtain digital support as in (Fig. 53). The sac is then opened by passing a hernia knife, as here shown, and the stone turned out by a proper scoop.

Prostatectomy :—

Should the operation be conducted with the object of removing growths of the prostate, the rectal bag should be emptied, so as to remove the engorgement of the prostatic veins. When necessary, as in the last operation, digital pressure will suffice to bring the prostate towards the abdominal wound. The growth may be removed by scissors, by enucleation with the fingers, or by cutting forceps.

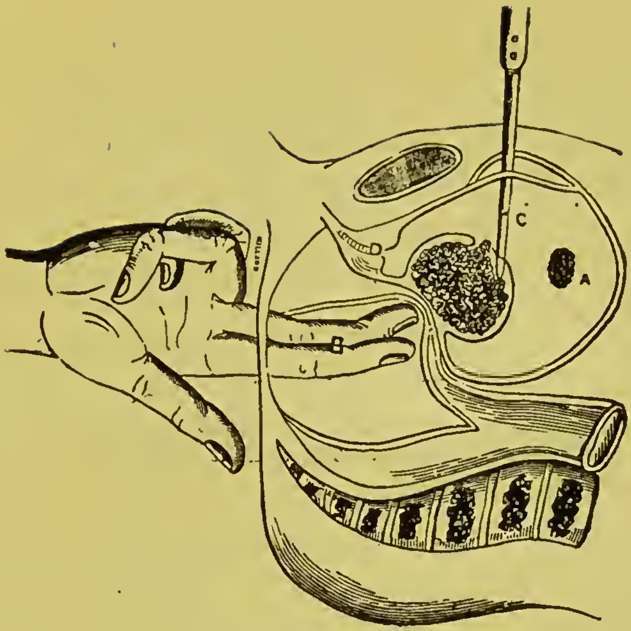


Fig. 53.

Tumour :—

When the object is the removal of a tumour, a wire or chain écraseur or galvanic wire may be employed, the catheter-like shaft of the instrument being passed through the urethra (Tobin). If the tumour has a well-defined pedicle, it may be snipped off after ligature. In some instances the finger-nail may be used for enucleation.

Suture of bladder :—

Should circumstances permit, the bladder may be sutured by hooking up the two ends of the incision and passing a number of interrupted sutures after Lembert's fashion, engaging only the muscular and connective tissue coats, or continuous suture may be employed. The third method is that of Braman, who passes a purse-string suture round in the sub-mucous tissue, thus inverting the mucous membrane, and then interrupted sutures in the muscular and connective tissue coat.

Drainage of bladder :—

If the conditions present, render complete closure impossible, the following methods of drainage are applicable :—

1. Thompson's, by a straight rubber tube.
2. Guiard's double curved supra-pubic rubber tube.
3. Perineal drainage, by a tube prepared as in (Fig. 54) and passed as suggested by Keyes.

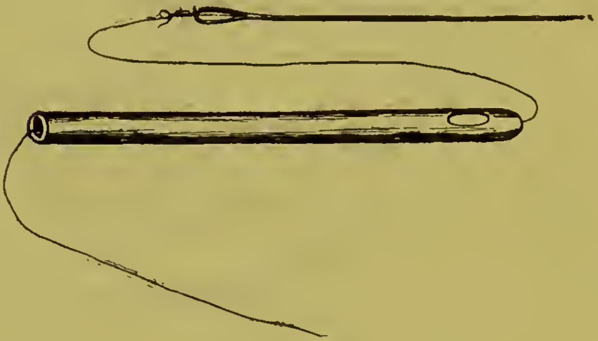


Fig. 54.

Treatment of abdominal wound :—

If complete suture of the bladder has been carried out, a drainage tube may be laid in the lower angle of the wound for 24 hours, the rest of the wound being closed by silk-worm gut sutures. These must entirely obliterate the cavity, and it is well to close the post-pubic cellular spaces by passing one of these sutures immediately above the pubes, and below the drain.

PERINEAL LITHOTOMY.

This operation may be conducted through a central, bilateral or lateral incision, as in Fig. 55; the latter is the one most frequently adopted.

Lateral Operation.—After placing the patient in the proper position, the superficial incision is made 3 inches in length, extending from 1¼ inches in front of the anus downwards and to the left between the tuberosity of ischium and the anus, inclining somewhat towards the former (B, Fig. 55).

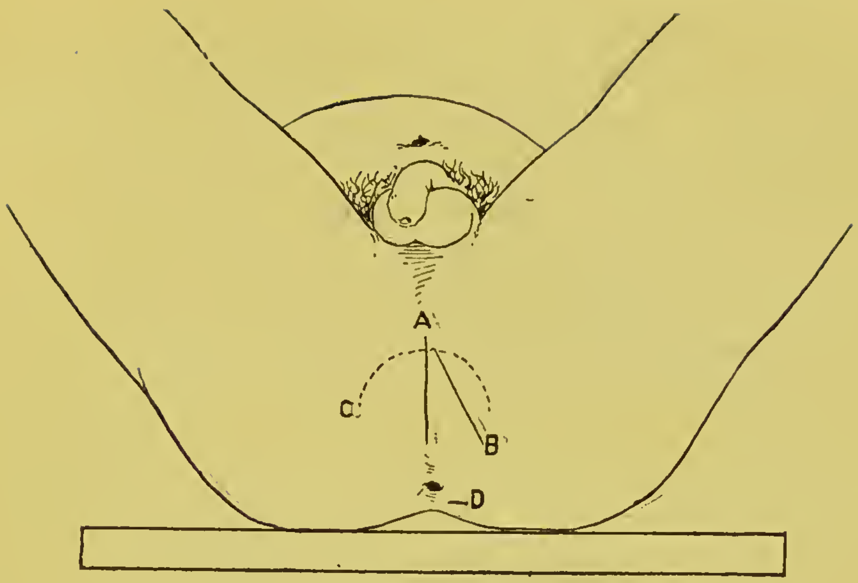


Fig. 55.

A. Median or Allarton's.
B. Lateral or Cheselden's.
C. Bilateral or Dupuytren's.
D. Section for Ischio-rectal Abscess.

Deep Incision: The index finger guides the knife to the groove in the staff. The point must engage this accurately, and be kept in it as it passes along to the bladder, the knife being at the same time inclined laterally, so as to follow the skin wound, thus cutting prostate obliquely. As the knife enters the bladder, urine gushes out; the knife is then withdrawn, increasing the extent of the incision. The finger is now introduced guided by the staff, which is removed when we feel certain that the bladder has been reached. A scoop or forceps is now introduced for the removal of the stone, properly located by the finger.

Accidents:—

1. Opening the pelvic cellular spaces.
2. Cutting into rectum.
3. Perforation of the bladder.

4. Hæmorrhage.
5. Tearing off mucous membrane of the bladder with forceps.

Treatment of Hæmorrhage :

1. Irrigation with hot water.
2. Petticoat catheter.
3. Sponge pressure.
4. Guyon's rubber tampon.

OPERATIONS FOR HERNIA.

Herniotomy—Inguinal.

Make an incision through the skin, over the neck and body of the tumour, its upper extremity being nearly midway between the anterior superior spinous process of the ilium and the tuberosity of the pubes, about one inch and a half above the level of Poupart's ligament, and its lower about the middle of the scrotum. This incision exposes the intercolumnar fascia which forms the first and thickest covering of the sac; divide the fascia after raising with forceps or on a director, when the cremaster muscle will be exposed, which must be cut in a similar manner. The division of these layers often causes great embarrassment and delay, for the operator, expecting to see the sac itself, when he has divided the integuments, mistakes this thickened covering and the cremaster muscle for the hernial sac, and cuts the fascia with extreme caution, fibre by fibre. Open the sac with great care, to avoid injuring the walls of the bowel, either seizing the sac with forceps, or raising it between the thumb and fingers. Make an opening sufficiently large to admit a grooved director, and divide the sac pressing the director firmly against its inside. If the intestine is connected with the sac by adhesions, an extraordinary amount of caution is required in opening the sac, as it contains little or no fluid; next, pressing the finger upon the sac, insinuate it through the external inguinal ring, to ascertain if there be any structures which firmly encircle the neck and orifice of the sac outside; if any are found, introduce a grooved director underneath, and cut them; make slight pressure upon the sac to return its contents into the abdomen; if reduction be impracticable, open the sac sufficiently to reach its orifice easily; pass the index finger along the anterior surface of the protrusion upwards towards the mouth of the sac, when the stricture will be encountered; the palm being upward, pass the hernia-knife flatwise along the finger or on a grooved director, through the mouth of the sac; turn the knife so as to cut parallel with the linea alba, and divide the structures in contact with it sufficiently to allow the ungual phalanx to pass freely into the abdominal cavity.

Radical Cure :—

Incision: Oblique, three inches in length, extending one inch above the external ring.

Dissection: After exposing the sac it is advisable to pass the finger upwards to reach the internal abdominal ring, and using it as a director to freely open the canal, so that the mouth of the sac may be reached without traction.

Treatment of sac :—

When possible the sac should be dissected up, and after opening it to see that none of the contents are retained, it should be transfixed and ligatured, Bantock's or the Staffordshire knot shown at page 6 being used. Then the sac is resected, and the stump fixed by a single suture within the abdominal ring.

Closure of canal :—

The canal is best closed as done in the accompanying plate (Fig. 56), by a Macewen's suture. If necessary, a suture may be applied above, and another below in order to make things more secure.

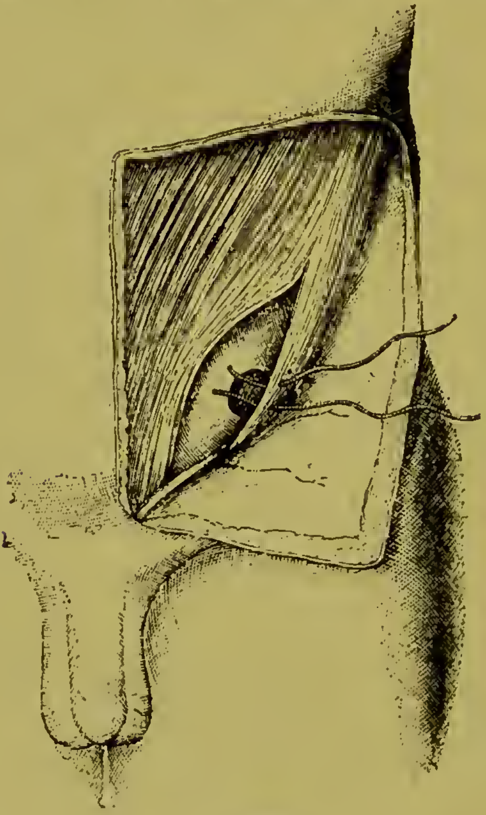


Fig. 56.

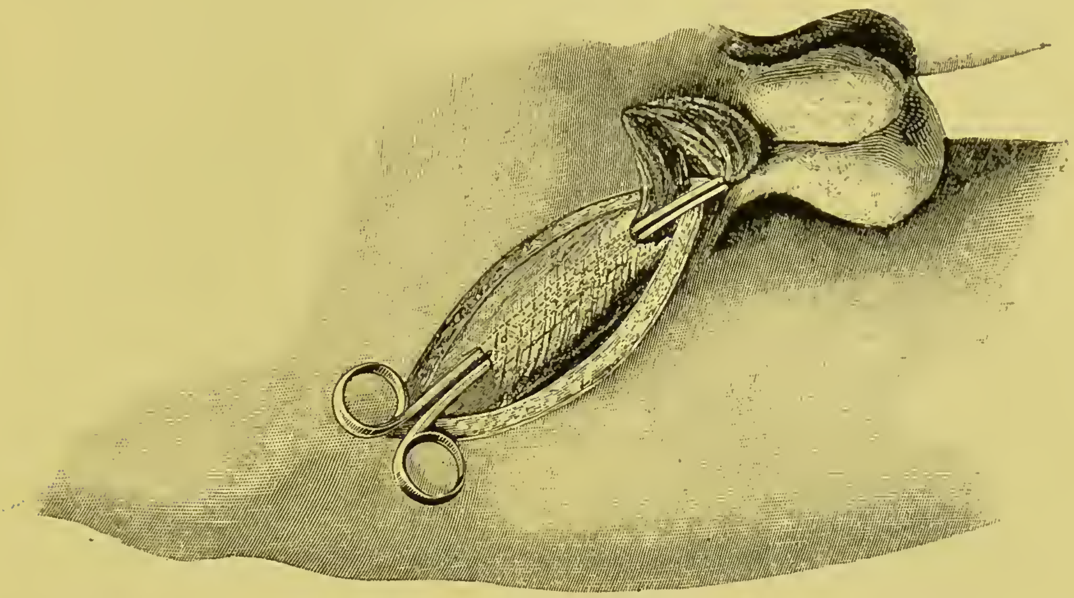
Closing the wound :—

After continuous suture of the external oblique tendon stout sutures should be passed, obliterating entirely any cavity.

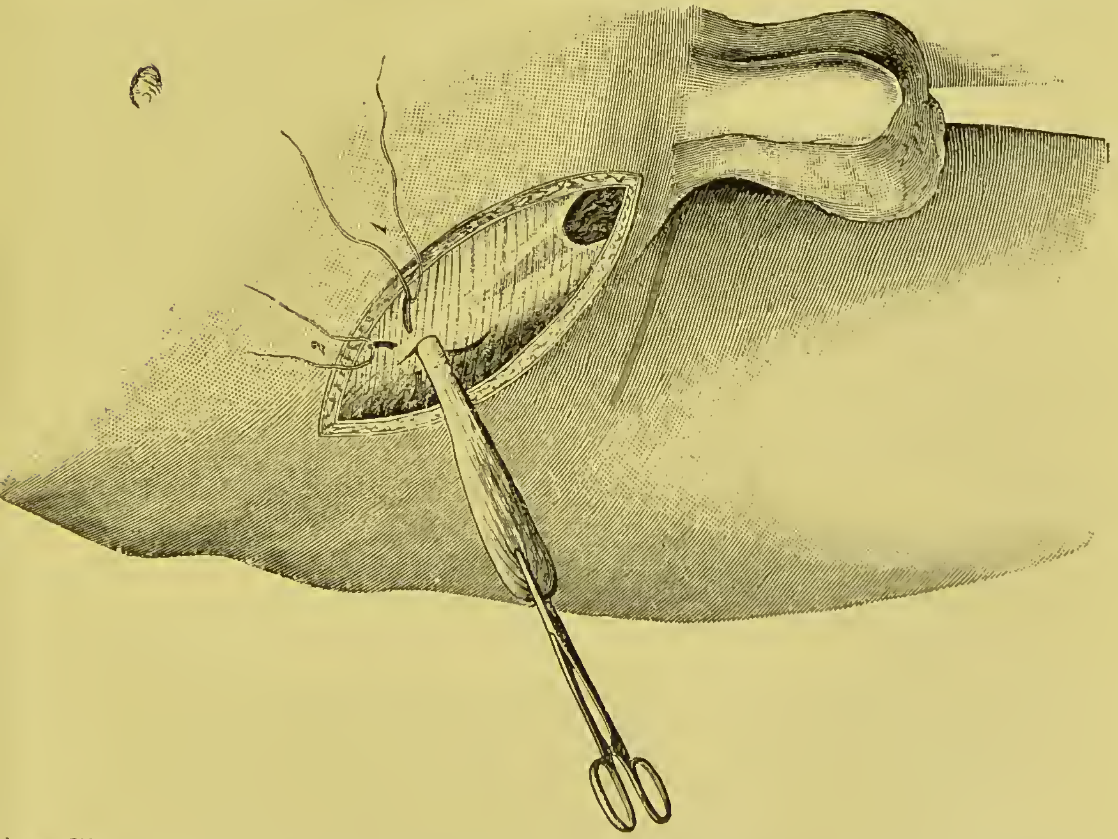
Other methods of dealing with sac :—

1. Twisting and pushing into the abdominal ring.
2. Folding it upon itself, transfixing it. and suturing inside the abdominal ring (Macewen).
3. Resection and suture of the mouth.
4. Displacement method (Köcher).

PLATE XVIII.—DRAWING THE HERNIAL SAC THROUGH INGUINAL CANAL AND EXTERNAL OBLIQUE.



FIXING THE SAC AT POINT OF PERFORATION OF OBLIQUE TENDON.



hese Plates show the second and third steps of Köcher's displacement method of dealing with the sac of inguinal hernia, and when combined with Macewen's suture of the conjoined tendon to Poupart's ligament under the external pillar of the abdominal ring, a thoroughly secure closure of the inguinal canal is brought about.

Herniotomy—Femoral.

Make an incision down to the superficial fascia from an inch and a half above the crural arch, in a line with the middle of the tumour, downward to its centre below the arch; divide the skin and superficial fascia, which in recent hernia is very thin and may escape notice, or in very large hernia may be inseparably united to the fascia propria, cribriform, or deep fascia; the latter must not be mistaken for the sac; divide this fascia longitudinally from the neck to the fundus of the sac and expose the layer of fat between the fascia propria and the sac with the director, on which the entire sac is laid open; introduce the finger gently into the sac, between the intestine and its anterior part, on which carry the hernia-knife into the crural sheath; divide the sheath as far as the anterior edge of the crural arch, or Poupart's ligament, a distance not exceeding half an inch in small hernia; if the intestines, when slightly compressed, cannot be readily emptied, the finger must be pressed at least half an inch higher under the posterior edge of the crural arch and the fascia transversalis, and the knife, carried within the stricture, must be inclined obliquely inward and upward, at right angles with the crural arch; divide the stricture in that direction sufficiently to liberate the intestine and admit of reduction. In very large herniæ it is admissible to divide the stricture external to the sac, but in small herniæ the risk of gangrene is such as to render opening the sac necessary; if the intestines adhere to the sac, separate them with great caution with a sponge, or if the adhesions are short and very firm, portions of the sac must be cut away and returned into the abdomen with the intestine, to which they adhere, and the stricture must also be divided with great care, fibre by fibre.

Radical Cure:—

Incision: Vertical from one inch above Poupart's ligament three inches downwards, over femoral ring and canal.

Dissection:

To reach the mouth of sac it is often necessary to slit up falciform process.

Treatment of sac:

Ligature (Bantock), resect, and suture stump behind Poupart's ligament.

Closure of femoral ring:

Pass a stout silk suture deeply through the pectineus muscle and fascia, dissect up a piece of the muscle, and then draw this as a pad inside the ring.

Closure of wound:

Buried sutures are necessary here to obliterate the cavity; avoid in passing them the femoral vein and the saphena.

UMBILICAL.

Radical Cure:—

Incision:

Two semi-lunar incisions are made so as to remove an elliptical piece of skin. The surrounding skin is then freed from the neck of the sac, which in turn is separated from the aponeurotic ring.

Treatment of sac:

It is first opened to see that no contents adhere to its inner surface. Then a purse-string suture is passed round it (as shown in page 8 and in A, Fig. 57), and drawn tightly, the section of the sac being made a quarter of an inch from line of suture.

Treatment of ring:

The dense ring which surrounds these old-standing herniæ does not readily close unless the edges are revivified. It is therefore necessary to pare the edges with a curved scissors, before passing the sutures, as at B, Fig. 57.

Closing of wound:

A few stout sutures, embracing the entire thickness of the abdominal wall being passed, some skin sutures complete the operation.

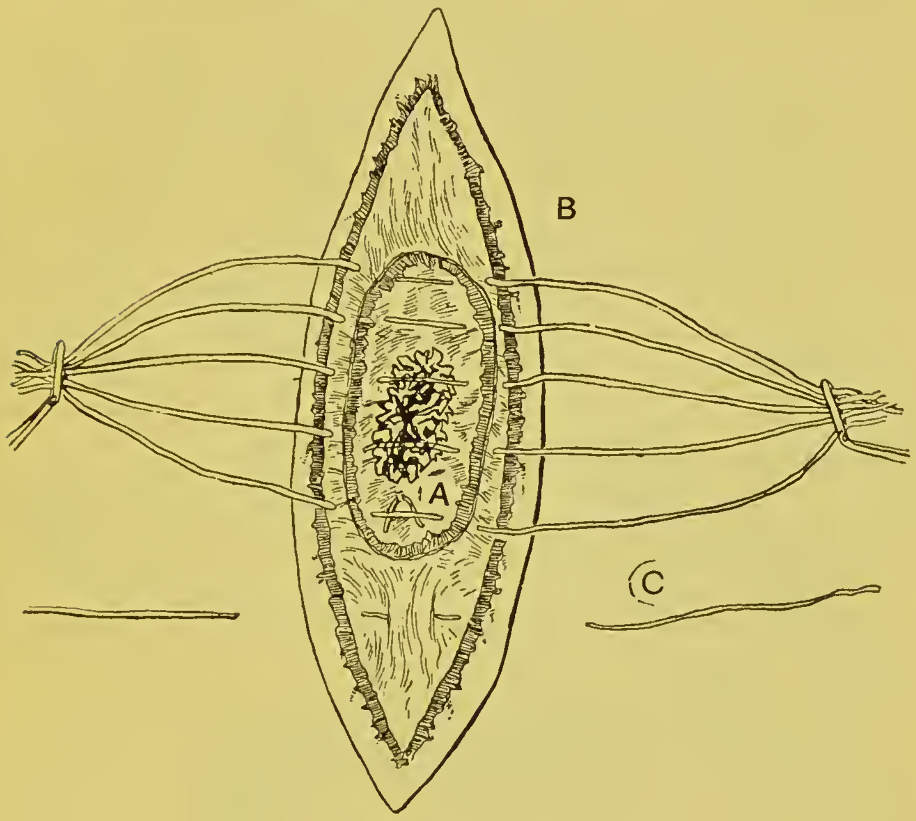
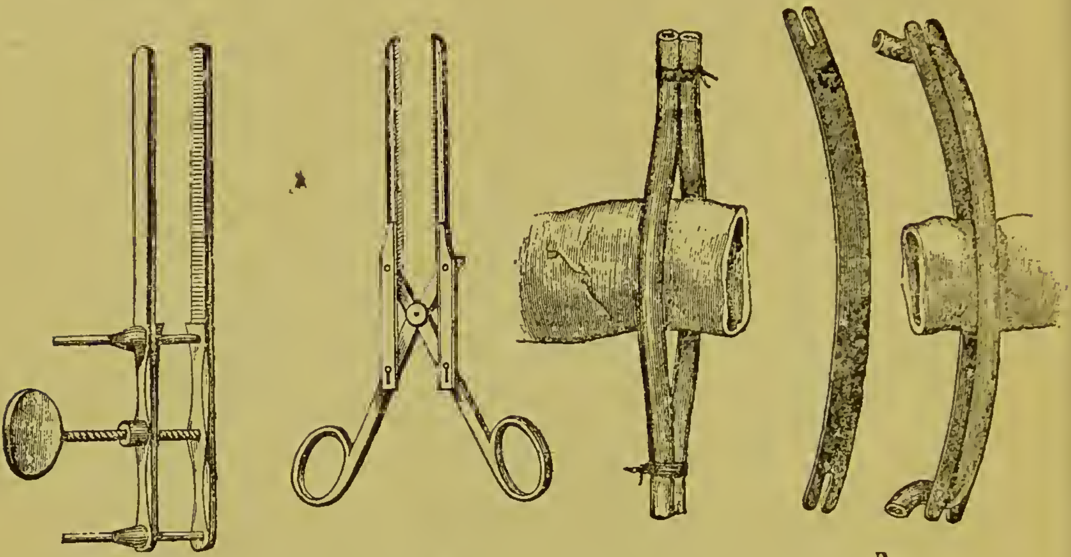


Fig. 57.

RESECTION AND SUTURE OF THE INTESTINES.

After opening the abdomen, and before proceeding to cut through the intestine, it is necessary to prevent the contents of the gut from escaping during the suture, There have been numerous clamps devised for this purpose. most of which are here depicted. Of these, the one used by Murphy (59), or that mentioned by Billroth (58, A), would seem the most useful, but the fingers of a reliable assistant will act more efficiently than any mechanical appliance. The portion of the intestine to be resected should be drawn well through the abdominal wound, and during section irrigation with warm saline solution should be resorted to.



A. Billroth.

B. Gussenbaur.

C. Rydygier.

D. Heinecke.

Fig. 58.

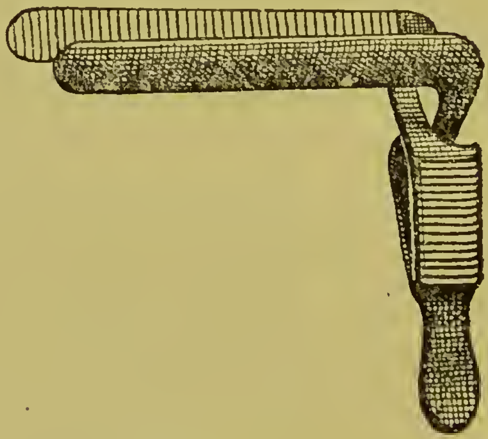


Fig. 59.—Murphy.

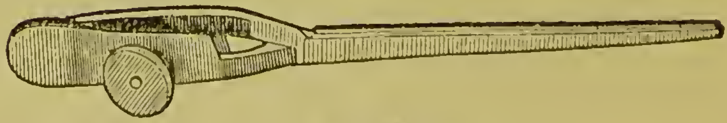


Fig. 60.—Makins.

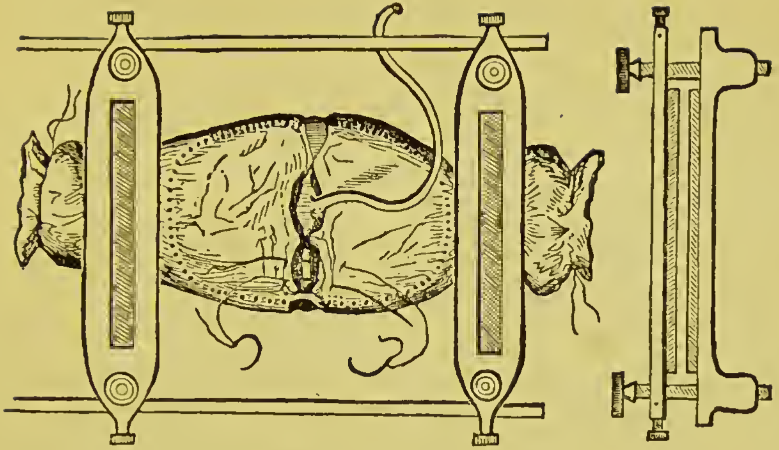


Fig. 61.—Treves.

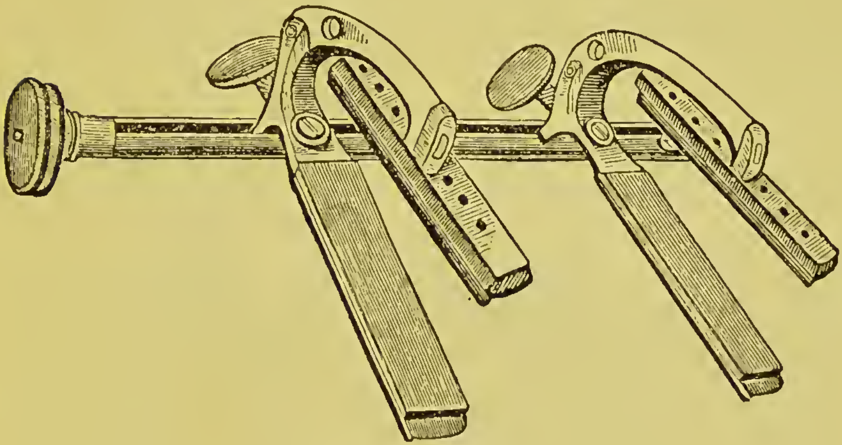


Fig. 62.—Bishop.

Numerous as are the clamps, the methods of suturing are still more diversified. Amongst these may be mentioned the continuous suture of Dupuytren, the crossed continuous suture of Gély (page 7), the mucous sutures of Czerny, and the interrupted suture of Lembert (page 7). Of these methods of suture, the latter is undoubtedly the best. Kocher recommends a continuous mucous catgut suture and a continuous silk one engaging the sero-muscular walls.

Methods of bringing portions of the Intestinal Tract together.

These may be divided into:—

1. End to end approximation where the pieces to be united have the same size of lumen.

2. End to end approximation where sizes of tube differ, as stomach to duodenum.

3. Lateral approximation.

(No. 1) may be carried out by suturing after some of the methods described, and without any support for the line of suture. One end may be passed into the other (Jobert's invagination method). A decalcified bone tube may be introduced into the lumen of the tube so as to steady the structures during the operation, and support the line of suture during healing (Paul), or Murphy's button may be employed in carrying out a rapid end to end approximation.

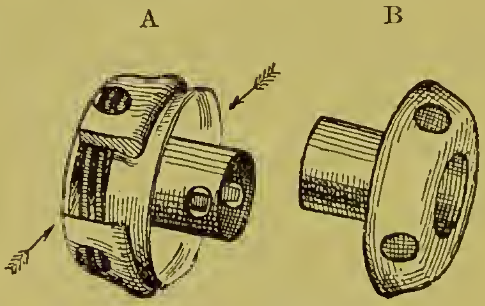


Fig. 63.

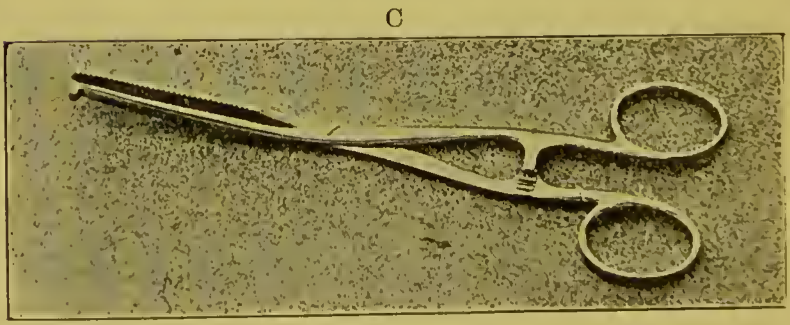


Fig. 64.

A Male button.
B Female button.
C Forceps for introducing A into bowel.

(No. 2). When it becomes necessary to join the large and small intestines together, it is well to close, in great part, the lumen of the large bowel, so as to make the opening accommodate itself to the size of the small intestine, or, when circumstances demand it, by cutting the small intestine obliquely its lumen may be made larger; but when it can be applied, a better procedure than either of these is to completely close the cut end of the large bowel, and, selecting a convenient place in a healthy part of the tube, make an opening the proper size to receive the mouth of the small intestine. This avoids difficulty in suturing angles, which is necessary in other methods.

(No. 3). Lateral approximation can be much more rapidly carried out than either of the other two. The latest and apparently the most rapid and successful procedure is that of Murphy, in which the metallic button (Fig. 63) is employed in the following way:—

A purse-string suture is passed round the situation in which the incision is to be made, then the bowel is opened sufficiently to admit the button passed in edgeways. It is retained within the bowel by a clip-forceps while the suture is drawn, and until a second button is introduced in a similar way into the opposite piece of intestine. Now the buttons fixed by the purse-string suture (which at the same time inverts the mucous membrane) are grasped with the fingers, the forceps are removed, and the buttons fixed by pressing them together.

The other methods of carrying out this procedure are:—

1st. Senn's bone plates.

2nd. Simple suture.

3rd. Using slices of raw potato after the fashion of Senn's plates or rings of rubber tube, making a sort of internal quilled suture.

Methods of dealing with the Mesentery :—

After the resection of a piece of the small intestine, the mesentery remains to be dealt with.

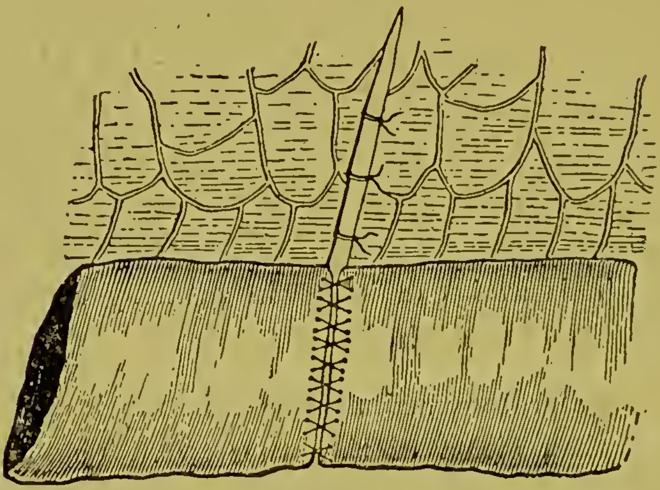


Fig. 65.

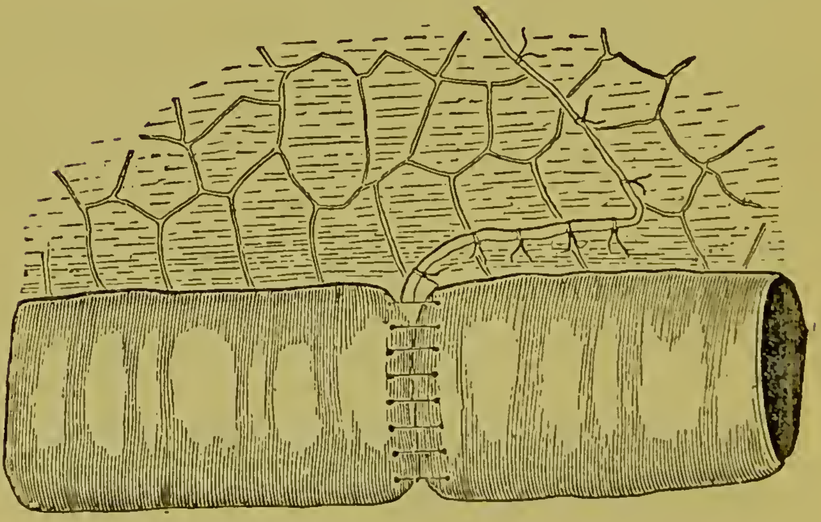


Fig. 66.

The various methods of treating it are here depicted. Fig. 65 shows a resection of a V-shaped piece of that membrane and suture of the cleft. Fig. 66 shows a folding down of that membrane on itself, so as to obliterate any sac that might be produced by the third method here depicted (Fig. 67)—that is, the suturing of the free margin of the fold.

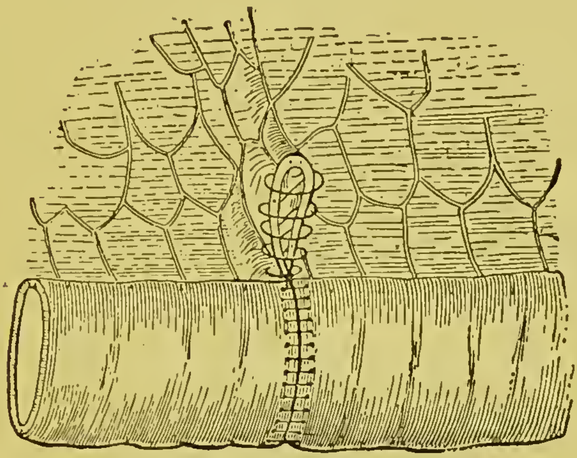


Fig. 67.

GASTROSTOMY.

Operation.—An incision (Figs. 51 and 68), from one and a-half to two inches in length, is made parallel to, and half an inch on the inner side of, the cartilages of the left false ribs, ending below at the level of the base of the cartilage of the ninth rib, which corresponds to the depression that can be felt just above the point of the tenth rib (Fig. 68). The incision is carried down layer by layer, and the peritoneum divided upon a director. The stomach is recognised just below the left lobe of the liver by its white colour, smooth surface, and the arrangement of its arteries. If it does not present in the wound it must be sought for by passing the fingers along the border of the liver, and pressing the transverse colon downwards.

When found, the stomach is seized with pronged forceps, and drawn up into the abdominal wound. At this stage Verneuil secured the stomach by transfixing its wall with two long acupressure needles, crossing the cutaneous wound at right angles, incised it, and fastened the edges to the skin with fourteen silver sutures. Labbe, before opening the stomach, fastened it to the abdominal wall by eight silver sutures, passed by means of sharply curved needles, which were made to transfix the abdominal wall nearly half an inch from the edges of the incision. By this means the two peritoneal surfaces, visceral and parietal, adjoining the incisions were maintained in contact, and their immediate union favoured.

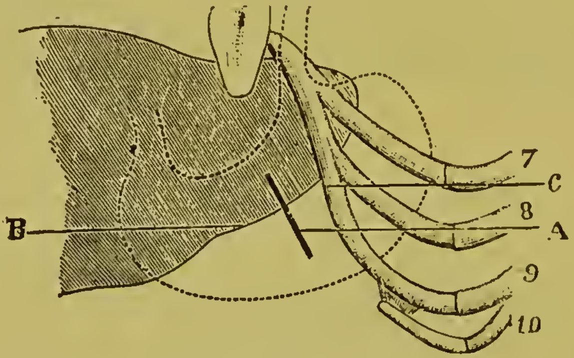


Fig. 68.

Rapid Gastrostomy.—Besides the method above described, permanent opening in the stomach may be made directly after the method described by Paul in the *Lancet*, 23rd December, 1893. In this method, purse-string sutures are passed round the intended point of opening, as in A, Fig. 69. Through the incision made in the centre, a glass tube is passed. The sutures being drawn so as to make the stomach embrace this tube closely, are brought out through abdominal incision, each suture being tied over a glass rod which rests on the abdominal wall (3, Fig. 69). These sutures serve the double purpose of preventing extravasation through the stomach wound, and of keeping the peritoneal covering of that organ closely applied to the parietal layer. The tube can then be used for irrigation of the stomach, and for the introduction of nutrient material.

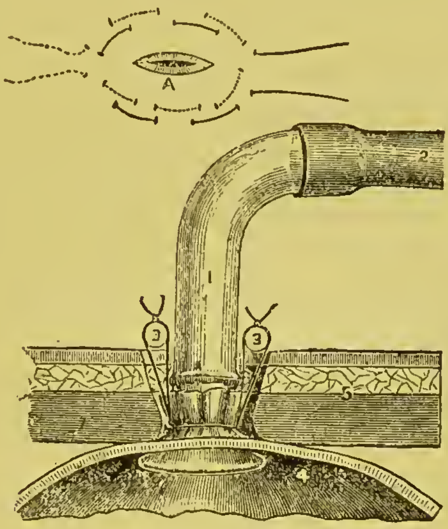


Fig. 69.

The method of valvular opening is a much slower procedure, and is not by any means as certain as the one just mentioned.

CHOLECYSTOTOMY.

Having felt the position of the hepatic notch, make an incision from the margin of the ribs over it directly, or almost directly downwards, cutting carefully through the various textures until the peritoneum is reached; seize this carefully by two pairs of forceps, and pull it backwards; make an opening between the two pairs of forceps large enough to introduce the finger; search with it for the gall-bladder, and having found it, cautiously bring its fundus towards the wound, and seize it by a pair of forceps; if it is distended it is first of all tapped and emptied; if it is not distended, or if it has been emptied, lay it open by scissors or forceps to an extent sufficient to get a finger in; then seize the edges of the wound by forceps, and secure any bleeding points; then explore the bladder, and by means of forceps or scoop remove all of the stones within. If the stone is impacted in the duct, it may be broken up by strong forceps. Apply a continuous suture so as accurately to close the peritoneum by uniting the edges of the wound of the abdominal wall to the edges of the wound of the gall-bladder, the two peritoneal surfaces being carefully joined to each other. Place an Indian-rubber drainage tube in the wound, and retain it for six or seven days, until it is possible to remove the stitches; if stitches are removed along with the drainage tube, the wound speedily heals, and if all of the stones have been removed the patient is already cured. If the wound re-opens and bile discharges, or mucus, from the gall-bladder, the remaining stone which occludes the passage must be dealt with.

COLOTOMY.

Lumbar.—Callisen proposed a vertical incision a little external to the outer border of the erector spinæ; Amussat made a transverse one midway between the last rib and the crest of the ilium, while Baudens and Bryant used an oblique one passing downwards and outwards at an angle of 45°. The latter is to be preferred, because, while giving sufficient room, it inflicts less injury upon the vessels and nerves of the parts, the general direction of which is the same as that of the incision.

The operation is performed as follows:—The patient is etherized, and placed in the prone position with a slight inclination to the right, a hard cushion being placed under the left side of the abdomen to raise and support it. The anterior and posterior superior spines of the left ilium are then recognised, a vertical line drawn upwards from a point one-half to three-quarters of an inch behind the centre of a transverse line drawn from one to the other. This vertical line should be marked with iodine or nitrate of silver, in order to serve as a guide during the operation.

A transverse or an oblique incision four or five inches long is then made, its centre lying in the vertical line above mentioned, midway between the last rib and the ilium. The underlying tissues are recognised and divided layer by layer, until the fascia transversalis and quadratus lumborum are reached. The former is next carefully divided, and if the adipose tissue covering the colon does not then appear in the wound, the latter should be enlarged on the inner side by dividing the outer fibres of the quadratus.

The intestine must always be sought for in the angle of the wound nearest the spine, and whenever it is desired to increase its exposed area this must be done in the same direction. Bleeding should be arrested as it occurs, certainly before the intestine is opened.

The colon can usually be recognised by its distension and greenish hue, and possibly by one of its longitudinal bands. Additional light may be thrown upon the correctness of the recognition, by noticing whether the supposed colon corresponds exactly to the vertical line marked upon the skin, and whether or not it moves up and down with the acts of inspiration and expiration, for while the small intestine has this motion the lumbar colon has not.

Two stout ligatures are next passed by means of curved needles through the presenting portion of the intestine, and used to draw it up into the wound, and fasten it to the skin at the sides of the incision. The wound is then filled with sponges or lint, and the bowel opened by a longitudinal incision. As soon as the discharge has ceased, the sponges or lint are withdrawn, the parts cleaned, the extremities of the tegumentary wound closed with silver sutures, and the edges of the opening in the intestine made fast to the skin with a few sutures of fine silk.

Littré's.—An incision one inch in length, is made parallel to, and a little above the outer half of Poupart's ligament, and the tissues, including the peritoneum, divided layer by layer. The sigmoid flexure, which can be recognised by its irregular lobulated surface and its comparative immobility, is then sought for, drawn into the wound, and treated in some of the ways above described.

METHODS OF FIXING THE BOWEL TO THE ABDOMINAL WALL.

(*a*) For immediate opening:—

1st. By passing a stout silk suture through one side of the wound, then through the bowel and out through the opposite lip of the wound. One of these across each angle of the wound gives you, when the bowel is opened, four supporting sutures, which hold the intestine in place. This method is admissible in the lumbar operation.

2nd. Careful suturing of the peritoneal coat of the bowel to the skin after fixing the parietal peritoneum by a few sutures round the lips of the wound.

3rd. By introducing a circular bone plate with large central opening, the threads passing through the entire thickness of the abdominal wall and being held in position by small suture buttons placed on the skin. By this means the visceral and parietal layers of peritoneum are held in contact (this method may be adopted where a temporary opening is required).

4th. A Paul's glass tube may be used after the fashion shown in the operation of rapid gastrostomy (Fig. 69).

(*b*) When the operation is conducted in two stages:—

1st. Allingham passes stout threads through skin and mesocolon.

2nd. Madyl draws intestine well out through the wound and passes a rubber cylinder wrapped in iodoform gauze through the mesentery, and leaves it supported by the skin on each side of the wound.

3rd. Lauenstein sutures the parietal peritoneum to the skin, and then passes supporting threads through the meso-colon.

4th. Jacobson passes tempered steel pins through the bowel to support it outside the wound.

To prevent fæces passing to the rectum :—

1st. Madclung inverts the edges of the lower piece after transverse section and sutures the opening.

2nd. Jones raises the mucous membrane of the upper part, and with it closes the lower end.

3rd. The spur produced by primary transfixion of the meso-colon acts as a valve to prevent the downward course of the fæces.

OVARIOTOMY.

Incision should be made in the median line between umbilicus and pubes, nearer the pubes, cutting through the skin, the superficial fascia, the aponeurosis, and the sub-peritoneal fat, down to peritoneum. The peritoneum is opened between forceps. The extension of the peritoneal opening is made by introducing the fingers as directors into the peritoneal cavity, and snipping by a scissors up to the required length.

Separation of adhesions :—

> Fresh adhesions are easily separated by sweeping the hand flat-wise over the surface of the tumour. Old adhesions have to be cut between ligatures. Firm adhesions between intestines and tumour must be separated at the expense of the tumour, taking care to

remove all epithelial cells. Much assistance may be had by using a sea or gauze sponge in the separation of fresh adhesions.

Evacuation of contents :—

The cyst must be supported by an assistant, and pressed into the abdominal incision. The trocar must must be plunged into the cyst well above lower angle of wound, so as to tap large cyst and prevent the contents soiling the peritoneum.

Cysts having thin watery contents are easily emptied through the canula; those containing gelatinous material must be emptied by introducing the hand within the cyst and scooping out its contents.

Removal of Cyst :—

After evacuation of contents. the cyst is removed by traction with Nélaton's or Wells' forceps applied to its walls.

Ligature of Pedicle :—

The pedicle is transfixed by a stout silk ligature tied firmly in halves or sections. The free ends of the ligature from one side is made to embrace the entire thickness of the pedicle, and tied firmly. The mucous membrane of Fallopian tube must be snipped out, the stump disinfected and dropped. Ligatures may be applied to the blood vessels separately.

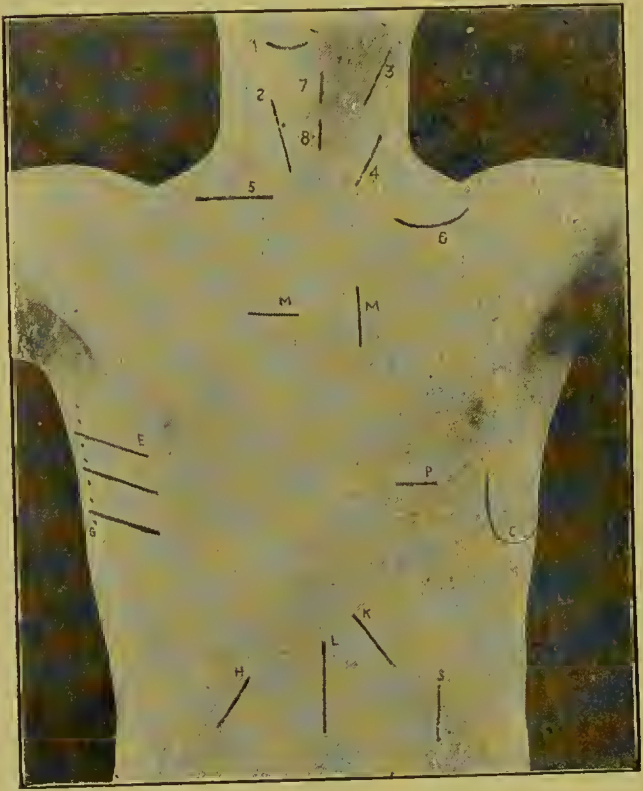
Toilet of the Peritoneum :—

The toilet of the peritoneum consists of the removal of blood or cyst contents, which may have escaped into the peritoneal cavity, either by a sponge or by a peritoneal douche of normal saline solution (a drachm of salt to a pint of water, 99° F).

The toilet of the peritoneum is only necessary where the peritoneum is soiled by septic or suspicious cyst contents, or by hæmorrhage.

PLATE XIX.

LINES OF OPERATION, FROM PHOTOGRAPH OF LIVING SUBJECT.



LIGATURE OF

1 Lingual.
2 Common Carotid.
3 External Carotid.
4 Inferior Thyroid.
5 Subclavian.
6 Axillary.
M M Internal Mammary.
7 Laryngotomy (Thyroid).
8 Tracheotomy (Superior).

SPECIAL OPERATIONS:—

E Esthlander's Resection of Ribs.
G Gould's Vertical Incision.
C Godlee's Flap Method.
P Incision of Pericardium.
H Incision for Hepatic Abscess.
K Gastrotomy.
L Loreta's Dilatation of Pylorus.
S Splenectomy.

Drainage of Peritoneum :—

The drainage of the peritoneum is effected by a glass or rubber tube. A drainage tube is employed where the peritoneum is soiled by suspected cyst contents, or in threatened hæmorrhage. A strip of iodoform gauze should be passed into the lumen of the drainage tube.

Closure of the Abdominal Wound :—

The abdominal wound may be closed by interrupted silk sutures, taking in the entire thickness of the abdominal wall and the peritoneum; or it may be sutured in layers, peritoneum to peritoneum, by continuous catgut sutures, muscular and aponeurotic layers to muscular and aponeurotic by catgut sutures, and finally, the skin by interrupted silk-worm gut sutures.

TRACHEOTOMY, &c.

SUB-HYOID LARYNGOTOMY.

A transverse incision two inches long, its centre in the median line, is made through the skin immediately below the hyoid bone, and the platisma, sterno-hyoid muscles and thyro-hyoid membrane divided; the mucous membrane, lying between the epiglottis and the base of the tongue, then presents in the incision, is drawn downwards with forceps, and opened with the knife or scissors; the epiglottis is then seized with a hook or pronged forceps and drawn out through the wound, freely exposing the larynx to view.

Velpeau made the first incision in the median line, divided the thyro-hyoid membrane transversely, and then plunged the knife backwards and downwards, making a vertical incision in the base of the epiglottis through which he passed the blades of a pair of forceps and withdrew the foreign body.

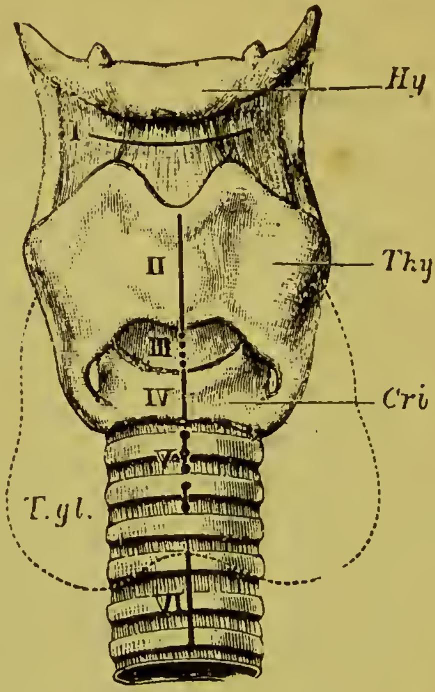


Fig. 70.

THYROID-LARYNGOTOMY. (*Thy*, Fig. 70).

In this operation the thyroid cartilage is divided vertically in the median line, between the anterior attachments of the vocal cords. It is suitable for the removal of foreign bodies or polypi from the interior of the larynx.

Steadying the larynx with the thumb and forefinger of his left hand, the surgeon makes an incision along the projecting angle of the thyroid cartilage, in the mediam line, from its upper border to the cricoid cartilage. As soon as the crico-thyroid membrane is exposed, he makes a small opening in it near its upper border, and passes one blade of a strong blunt-pointed pair of scissors through it to the upper border of the larynx, keeping exactly in the median line, and thus divides the thyroid cartilage throughout its entire length. Or a grooved director may be passed through the opening made in the crico-thyroid membrane, and the cartilage divided upon it with a curved bistoury. Or, again, the division may be made with the knife, layer by layer, from before backwards.

SUPERIOR TRACHEOTOMY.

The incision in the trachea should always be free enough to admit the canula readily, and should be made by a quick thrust with a sharp-pointed knife, which must be prevented from penetrating too deeply at first, by holding it close to its point. After the puncture has been thus made it is enlarged by gentle sawing movements of the knife, or with scissors.

The knife is retained in the trachea, as a guide, until the dilator or bivalve canula has been introduced. The best dilator is the three-bladed one; it is introduced closed, its blades then expanded, and the permanent canula passed in between them. The canula should be curved, double to facilitate cleaning, and with an opening on its convexity, through which the expired air can pass to the larynx.

Some surgeons steady the trachea by drawing it towards the chin with a tenaculum introduced at the lower edge of the cricoid cartilage. Gordon Buck used for this purpose a rather narrow lance-shaped knife, bent at a right angle on the flat, and also grooved on the back for use as a director.

INFERIOR TRACHEOTOMY.

The patient is placed upon his back, with shoulders raised and head thrown back. A trustworthy assistant, standing behind the head, holds it firmly in a straight line with the body; others control the patient's limbs, if he has not been anæsthetised. The surgeon, standing at the patient's right side, recognises with his finger the hyoid bone and thyroid and cricoid cartilages, and, marking with his left forefinger the lower border of the cricoid cartilages, makes an incision downwards from it in the median line, from one and one-half to two inches in length, according the size of the patient. He carries the incision through the skin and fascia, separates the sterno-hyoid and sterno-thyroid muscles with the handle of the knife, and lays bare the isthmus of the thyroid. If any large veins are encountered, they must be carefully drawn aside or divided between two ligatures, but bleeding from smaller ones may be safely disregarded; for, as Trousseau pointed out, it will cease as soon as the trachea is opened, and the venous congestion relieved by the admission of air to the lungs.

It is well to have one or two assistants hold the sides of the incision apart during dissection, if they can be depended upon to do so without disturbing the relations of the parts by drawing too forcibly towards one side or the other.

The isthmus of the thyroid is next drawn upward with a blunt hook, and three or four rings of the trachea exposed below it, and divided from below upwards.

ŒSOPHAGOTOMY.

The skin incision will commence opposite to the upper border of the thyroid cartilage, and will be continued downwards along the anterior border of the sterno-mastoid muscle for about three inches.

The first steps of the operation are identical with those for ligaturing the common carotid.

As soon as the skin and fascia have been divided, the finger should be introduced into the wound, and the position of the impacted substance further defined.

The omo-hyoid muscle is drawn downwards, and must be divided if necessary. The sterno-hyoid and sterno-thyroid muscles must be drawn a little aside, and, in cases where the foreign bodies are low down, may need to undergo some division of their fibres.

The sterno-mastoid and the large vessels are drawn outwards. The carotid sheath is not disturbed.

The trachea and larynx are drawn over, or rather tilted over, to the inner or opposite side.

The position of the gullet can now be readily made out.

It may be desirable at this stage to pass a bougie or pair of œsophageal forceps, in order to accurately demonstrate the situation of the tube, and of the impacted body. It must be remembered that the œsophagus, when empty, is flat and tape-like and does not exist as the well-rounded tube which figures in most anatomical text-books.

The inferior thyroid artery and the superior and middle thyroid veins must be carefully avoided. The last-named vessels will usually need to be ligatured and divided.

All bleeding having been arrested, the gullet is steadied by a pair of fine long-blade toothed forceps, and is opened longitudinally over the side of the foreign body.

The recurrent laryngeal nerve runs in the groove between the œsophagus and the trachea. The gullet must be opened through its lateral wall, so as to avoid injury to this nerve. In the actual operation it will appear that the œsophagus is being opened as far back as possible.

The opening in the tube must not be extended by tearing, or be dilated with dressing-forceps; it must be cautionsly enlarged by a blunt-pointed bistoury.

The removal of the foreign body must be carried out with the greatest care, and a curved periosteal elevator will be found a most valuable instrument in freeing the substance and prizing it into the wound.

If the wound in the gullet be a clean cut, if the case be recent, and the foreign body have been impacted but for a short space of time, then the œsophageal incision may be closed, and this more especially applies to the cases of children and young subjects. The sutures employed should be of very fine catgut, and they can be most conveniently introduced by means of a curved needle, held in Hagedorn's holder.

If, however, the body has been long impacted, or if the wound in the gullet has been lacerated and has been exposed to much bruising, then the use of sutures is to be avoided. In any case of doubt, sutures had better be dispensed with. The skin wound may be narrowed above and below by a few suture points, but the median and main part of the wound must be left open. A good-sized drainage tube should be passed to the bottom of the wound. In no case is it well to entirely close the superficial wound, even in instances where the incision in the œsophagus has been united. The wound in the gullet may yield, or may be torn open by violent vomiting, and the food matters and mucus which find their way into the tissues of the neck should be permitted the very freest means of escape.

EXCISION OF TONGUE.

Excision of the tongue may be carried out through any of the incisions represented in Figs. 71 and 72, or through the mouth without any preliminary skin incision. The best method is that in which the removal with scissors is carried out after the ligature of the linguals (*Vide* Plate III.) The steps are as follows:—

Close the wound over the lingual vessels, by a single suture on each side, and cover with blue wool, held in position by a circle of bandage. Pass a stout ligature through each side of the anterior portion of the tongue, for the purpose of traction; then with scissors rapidly detach the tongue from the floor of the mouth and the anterior pillars of the fauces.

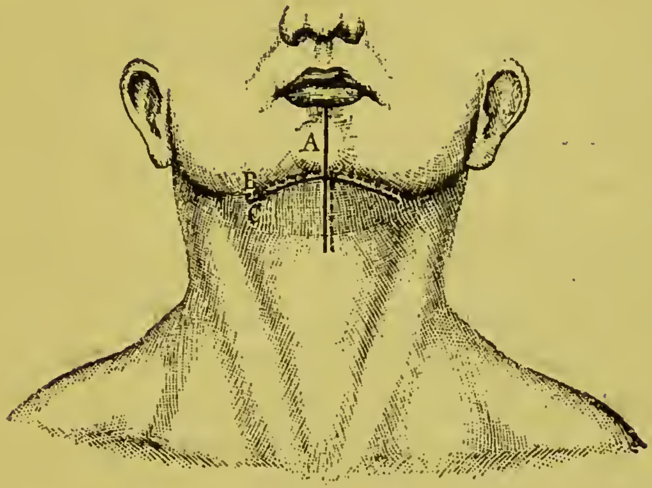


Fig. 71.

A Sedillot.
B Regnoli.
C Billroth.

The operator may ignore the trifling bleeding which takes place, and may complete the excision without let or hindrance. No time is occupied in securing the vessels, or in arresting slight hæmorrhage by sponge pressure. The surgeon's whole attention can be devoted to effecting the excision in the best possible manner; the area of the operation is not occupied by a pool of blood, and the attention is not withdrawn from the primary operation by a vigorous bleeding at a critical period.

No excision could be simpler or easier, nor more free from disturbing circumstances. It may, if thought desirable, be carried out with remarkable rapidity.

There is no need to insert a ligature through the tissues at the base of the epiglottis.

After the tongue has been removed a piece of Turkey sponge of suitable size is introduced into the mouth, and is pressed against the floor of the cavity.

The operation is completed by carefully dressing the cervical wounds, and thoroughly irrigating the mouth with boracic solution. When one side of the tongue only is engaged, and sublingual glands enlarged, the method of Köcher enables one to remove all the infected tissue. It is carried out as follows:—

Köcher's Method.—The patient having been placed in position, a preliminary tracheotomy is performed.

An ordinary canula is employed, and the pharynx is plugged with a clean sponge, which has been wrung out in carbolic lotion, and to which, as a security, a long silk thread is attached.

The mouth will have been already as well cleaned as is possible, and should have been very frequently rinsed out with some antiseptic solution. Chloroform is administered through the tracheal tube.

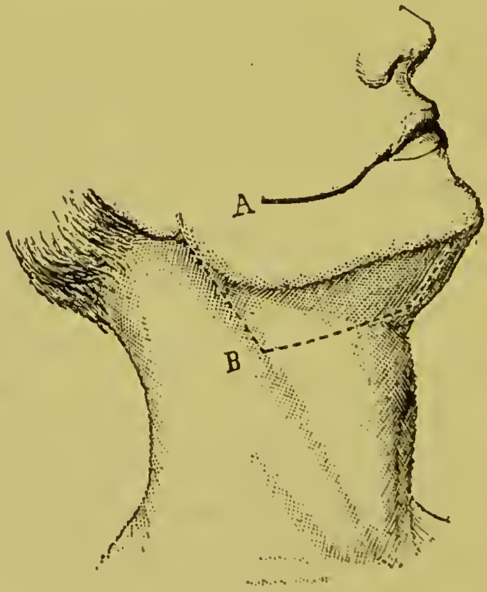


Fig 72

A Collis
B Köcher.

An incision is made in the neck. It commences just below the lobule of the ear, and runs along the anterior border of the sterno-mastoid muscle.

When the middle of this border of the muscle has been reached the incision is carried forwards to the hyoid bone, and thence to the symphysis along the anterior belly of the digastric muscle (B, Fig. 72).

The flap thus marked out is turned upon the cheek. The facial vessels are ligatured, as is also the lingual artery before it passes beneath the hyoglossus muscle. The submaxillary fossa is now evacuated, and the surgeon working from behind forwards. All the lymphatic glands of the region are removed and also the sublingual and submaxillary salivary glands, should the diseased tissue be near in association with them. The mylo-hyoid muscle having been cut through as far as is needed, the mucous membrane is divided close to the jaw, and the tongue drawn out through the opening.

The tongue may now be slit in the middle line, and one-half removed with scissors.

If the whole tongue need to be removed, the lingual artery of the opposite side must be ligatured through a separate incision.

The skin incision is not closed by sutures, but the whole wound is left open, and its cavity is plugged with gauze or with a sponge wrung out of carbolic lotion.

The wound is allowed, therefore, to close by granulation, while the freest possible vent is provided for the escape of all discharges.

The tracheotomy tube is retained until the wound is granulating healthily. It thus happens that the patient breathes fresh air throughout the most important period of the after-treatment, or at least, the air inspired has not passed through the mouth and over the wound surface.

TREPHINING.

The old-fashioned, crucial, T shaped and V shaped incisions, are now replaced by a semi-lunar one, and contrary to the directions in some surgical text-books, this should be made with its base towards the blood supply (downwards), Fig. 4, c. The incision should reach down to the bone, and great care should be taken in raising the flap that the periosteum is carried with it. Digital compression along the edge of the wound will arrest hæmorrhage, while the flap is being turned down. All bleeding points can then be secured by clip-forceps. Fine ligatures should be at once applied so as to leave the field of operation clear.

The flap should be much larger than the intended opening in the skull (Fig. 4). Should drainage be necessary, a slit can be made through the flap at the most dependent part, so that union along the suture line may not be interfered with.

The advantages of this flap are:—

1st.—There are no angles to be stitched.

2nd.—The line of suture is supported during healing by the subjacent bone.

3rd.—The scar does not lie on the dura mater.

Opening through the dura mater may be made by a crucial incision, and may be closed, if advisable by a fine catgut suture.

Operation.—The centre pin of the instrument is protruded about one-sixteenth or one-tenth of an inch, and is firmly fixed by the screw; the crown is then applied to the sound bone, near the fracture. As a rule it is so applied that two-thirds or three-fourths of the circle will be upon the sound skull, and the remaining third or fourth over the fractured area. The trephine should not be placed so far over the injured area as to produce trouble by jarring any fragment which may be lying in contact with the dura mater.

The point is bored into the bone, and then the trephine is made to cut into the skull by light, sharp movements from left to right, and from right to left.

At first the instrument may be steadied by the left forefinger, which rests upon the skull. As soon as a groove has been cut all round, the pin may be withdrawn, and the instrument will be found to maintain a steady hold of the part. The pressure must be evenly maintained throughout, and will be found to be chiefly exercised when the hand is turned from left to right (the supination movement). At first the bone-dust is dry, but as soon as the dense outer table is cut through, it becomes soft and bloody. As the trephine enters the diploe, the softer character of the resisting medium is at once recognised.

The wound in the bone must be kept constantly clear of dust by frequent irrigation and the use of the trephine-brush or the quill. The trephine itself is rinsed in a warm carbolic solution from time to time, to free it from *débris*. Those who have only experimented with the dry skull of the cadaver will be surprised at the ready manner in which the trephine cuts its way into the living bone. The depth of the groove in the skull must be estimated from time to time with quill. Inasmuch as the skull is spheroidal, it is exceedingly difficult to make the groove of equal depth all round. The shallower parts must be especially cut down to the level of the deeper parts, by bearing pressure on the bone at the points where the division has been less complete. As the inner-table is penetrated, increased caution must be exercised, and still more care is needed when once the groove has been extended right through the skull. It must be remembered that the bone will probably be of unequal thickness even over the small area covered by the trephine.

When the groove is of sufficient depth, the disc of bone may be removed by gently rocking the trephine to and fro while it is still in position, or by cautiously introducing an elevator at a spot where the bone is entirely divided. Not unfrequently the disc of bone can be grasped with forceps, and lifted out. In any case, some little portion of the inner table will have to be broken through.

MOTOR AREAS.

Since along and around the fissure of Rolando, are grouped the most important of the motor areas of the brain, it is advisable to study the methods of determining the course of this fissure. The following are the methods of finding that line on the head which corresponds thereto:—

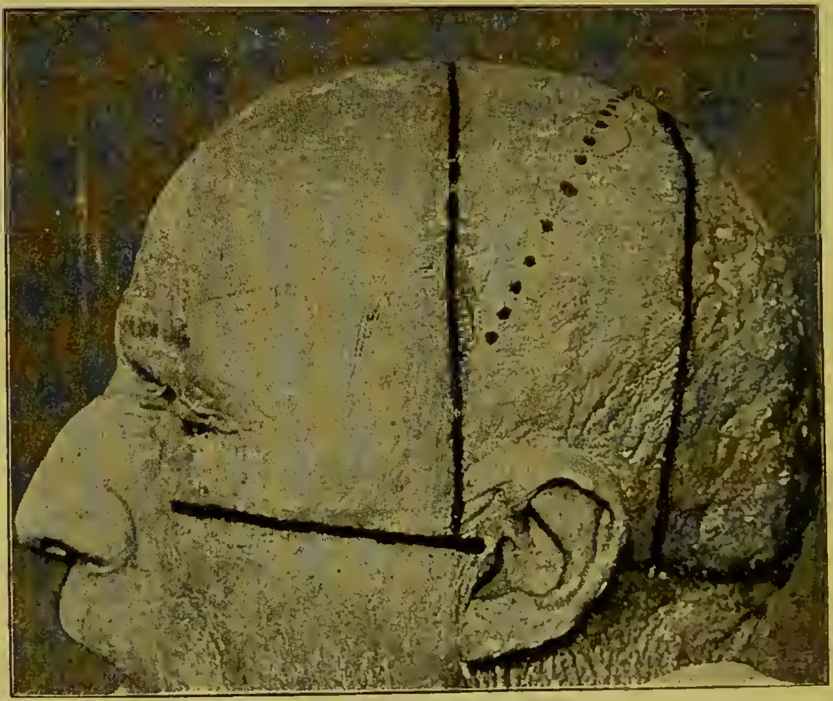
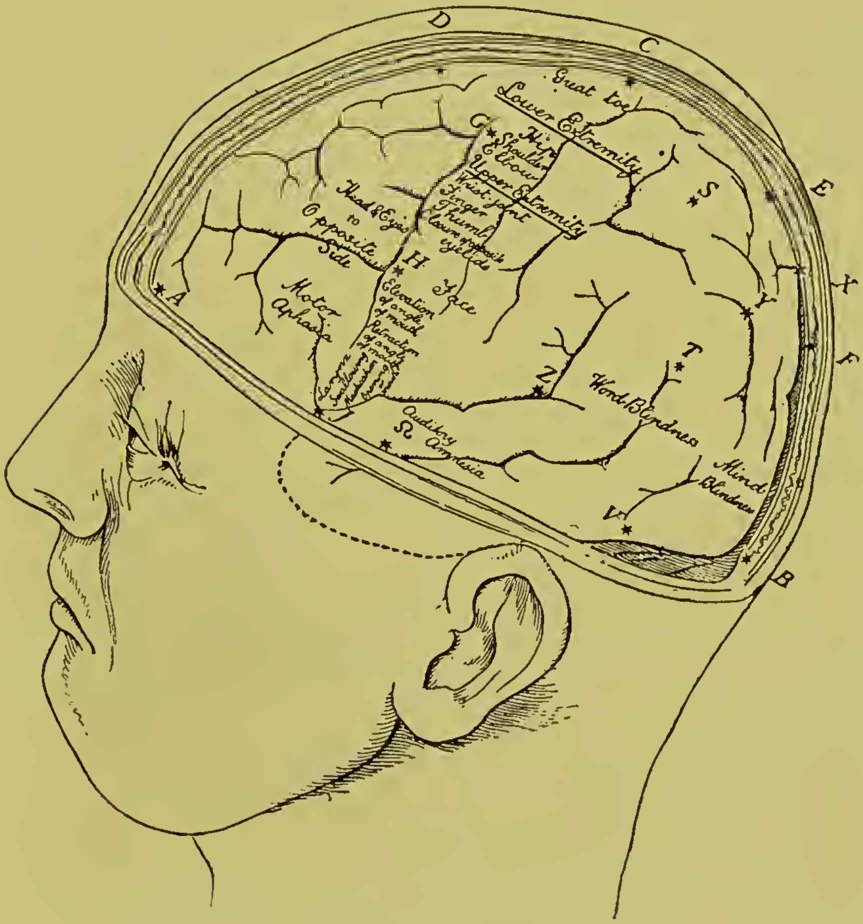


Fig. 73.
Base line vertical lines of Reid, dots mark fissure of Rolando.

THANE draws a line from half an inch behind a point midway between the root of the nose and the external

PLATE XX.—CORTICAL CENTRES.



According to Huxley.

occipital protuberance, downwards and forwards to a point two and a quarter inches behind the external angular process of the frontal.

Reid—From a base line, as in Fig. 73, a line is drawn at right angles from the tubercle of the zygoma to the top of the head. Another line is drawn in the same way from the the posterior border of the mastoid process. From the upper end of the latter an oblique line, running downwards and forwards to meet the former, two and a half inches from its lower end, or two and a quarter inches behind the external angular process will mark the line of fissure.

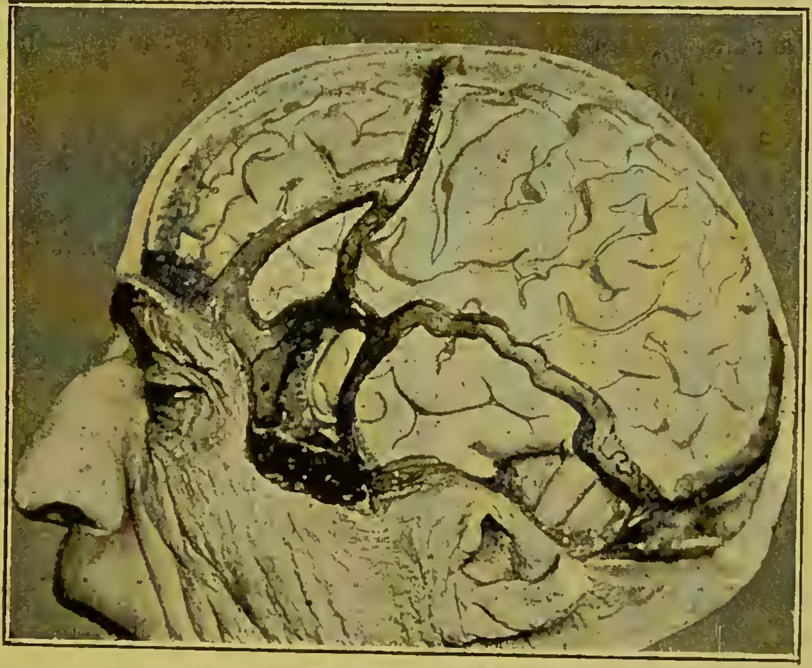


Fig. 74.

Exposed brain showing relation of brain to sutures and prominent parts of skull.

Championniere—A line is drawn across the vertex from one auditory meatus to the other, 55 mm. behind this line marks the upper end of the fissure. The lower end is marked by a spot 7 cm. behind and three above the external angular process of the frontal.

Hare—Find the upper end as in Thane's method, draw a line at an angle of 67° to the sagital suture, downwards and forwards, the upper three and three-quarter inches marks the Rolandic fissure.

Fissure of Sylvius.

This runs from one and a quarter inches behind the external angular process, and the same distance above the zygoma, obliquely backwards and upwards, to a little beyond, and three-quarters of an inch below the parietal eminence. The ascending limb of this fissure begins two inches behind the external angular process, and runs obliquely upwards and backwards.

To expose mastoid process:—

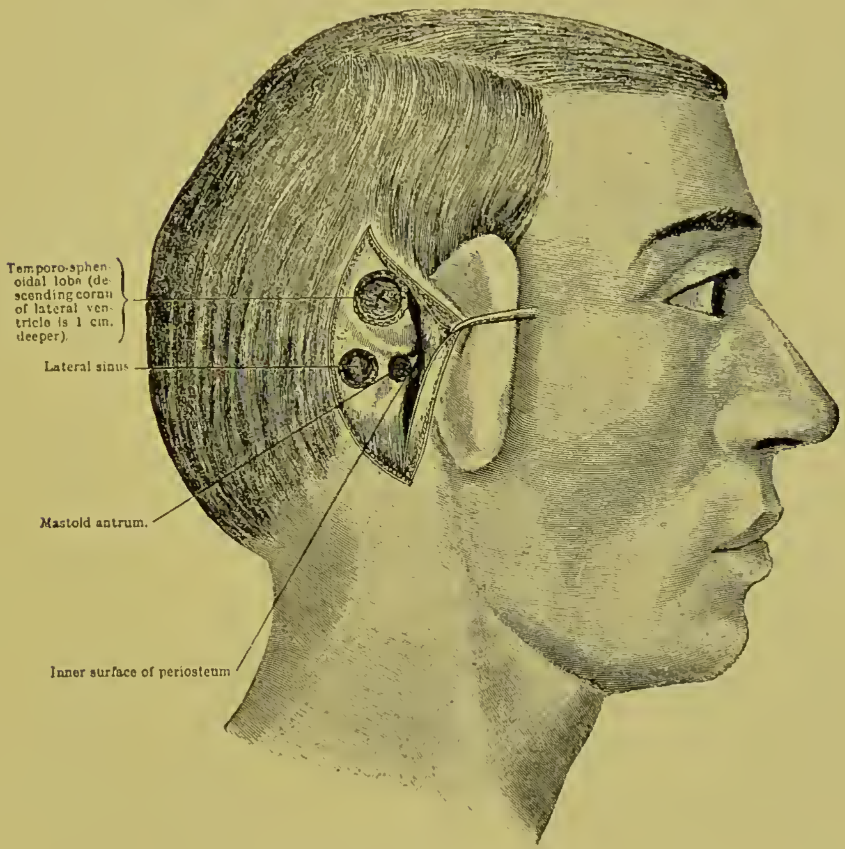
Wilde's Incision.—This incision is convenient for opening abscesses behind the ear, and for exposing the mastoid process. The incision is quite vertical and extends from the apex of the mastoid to its base. The apex of the bone is the guide to the position of the incision. If the knife be carried too far up, branches of the posterior auricular artery are divided. The incision is carried well down to the bone.

Trephining Mastoid Antrum.—An imaginary line is drawn through the roof of the auditory meatus at right angles to the line of Wilde's incision, and where these two lines meet the trephine is applied.

The instrument is bored forwards and inwards parallel with the long axis of the meatus. It is convenient to introduce a short piece of sterilised glass rod into the meatus as a guide, and to keep the trephine exactly parallel with it.

If the instrument be directed inward at right angles to

PLATE XXI.—OPENING MASTOID ANTRUM AND LATERAL SINUS AND EXPOSURE OF TEMPORO-SPHENOIDAL LOBE.


Temporo-sphenoidal lobe (descending cornu of lateral ventricle is 1 cm. deeper).
Lateral sinus
Mastoid antrum.
Inner surface of periosteum

It will be seen that the lateral sinus is reached by placing the Trephine between the temporal crest and the post prominent part of the mastoid. The temporo-sphenoidal lobe is exposed by opening the cranium above the temporal crest at a point corresponding to the middle line of the mastoid. Suprameatal spine marks site for opening the mastoid antrum.

the surface of the skull at the point indicated, the antrum will certainly be missed, and the lateral sinus almost as certainly opened; if too much forward, the bony wall of the meatus suffers.

KRONLEIN'S AREAS OF MENINGEAL HÆMORRHAGE.

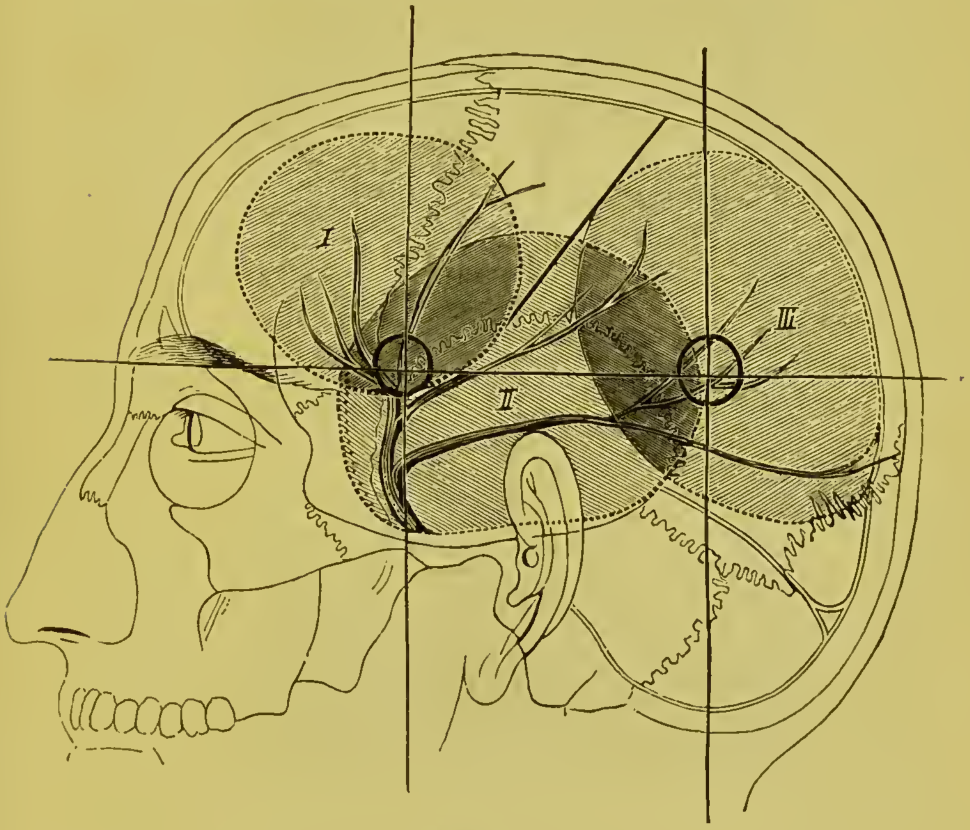


Fig. 75.

The above figure shows the positions in which hæmorrhage from the branches of the middle meningeal artery usually occurs, and the lines mark at the point of crossing the most favourable spots for trephining when compression results from such extravasation.

OPERATIONS FOR TENDO-SYNOVITIS.

Hand.—The accompanying figures show the position of the synovial sheaths of the tendons of the wrist, hand, and fingers, and the lines of incision to be made for the evacuation of pus and occasionally serum from these pouches. They are marked so as to indicate the lines of safety in carrying out this procedure. The incisions permissible in the fingers are confined to the phalanx, and must not extend over the flexures of the joint. A section in this position, releases the tendon entirely from its sheath, owing to cutting of the cruciate and annular ligaments. Nussbaum suggested a lateral incision for the relief of subthecal effusions—It is a safe and useful procedure as it runs between the dorsal and palmar digital vessels.

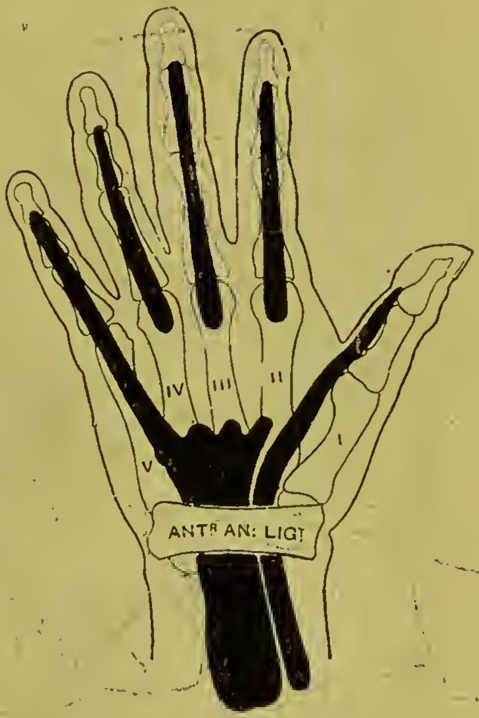


Fig. 76.

In opening into the palm, an incision should be made as at Fig. 77, E. A director inserted is held firmly against the palmar fascia, a knife passed along it can go with safety as far as the middle palmar fold. When openings are necessary to evacuate the sheaths of the thumb and middle finger, the lines indicated at C D, Fig. 77, may be taken as guides in the operation. When suppuration has extended to the sheaths behind the anterior annular ligament, the incisions at B B, Fig. 77, may be made. Care must be taken not to cut through the anterior ligament itself.

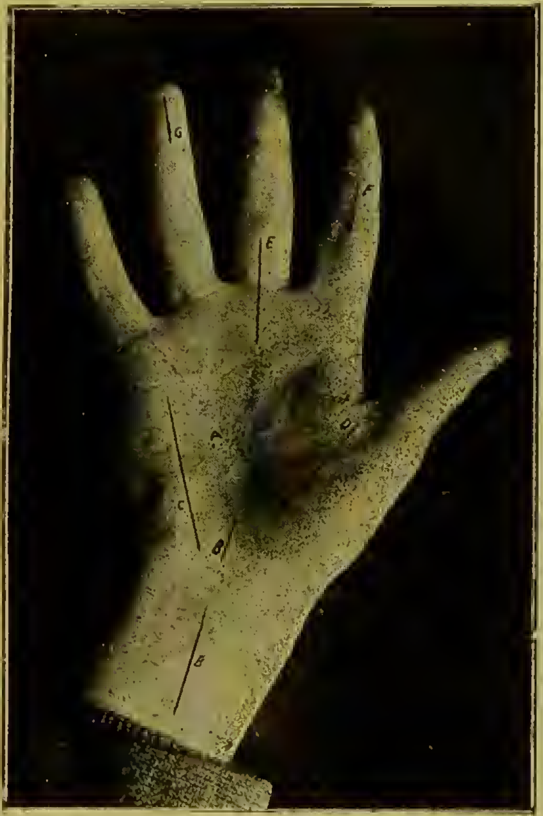


Fig. 77.

AMPUTATION OF BREAST

Operation.—The arm of the affected side being elevated to render the pectoral muscle tense, make the first incisions through the skin and connective tissue, in the form of an ellipse, or circle, the lower incision being first made to avoid the flow of blood; separate the attachments of the tumour from its connections on all sides. In arising the tumour from its deep connections, commence at the extremity towards the axilla, expose the pectoral muscle, and dissect downwards and forwards towards the median line until the entire mass is removed. If there are large glands towards or in the axilla, extend the incision as at *a*, Fig. 78, and remove them, using the handle of the scalpel to avoid wounding vessels or nerves During the dissection, control the hæmorrhage by pressure with dry sponges without stopping to ligate vessels. Benign tumours of the breast may be removed through a sub-mammary incision, as at *c*, Fig. 78.

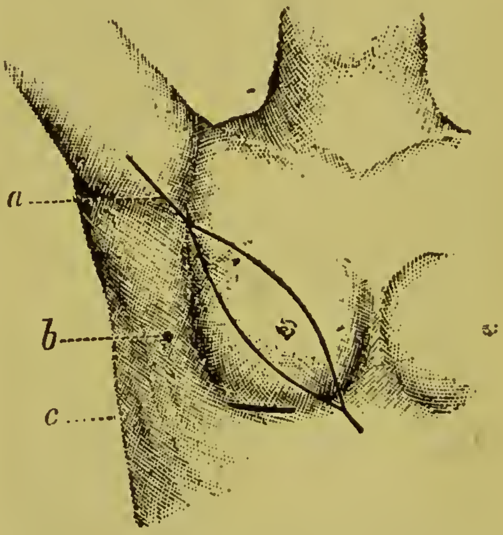
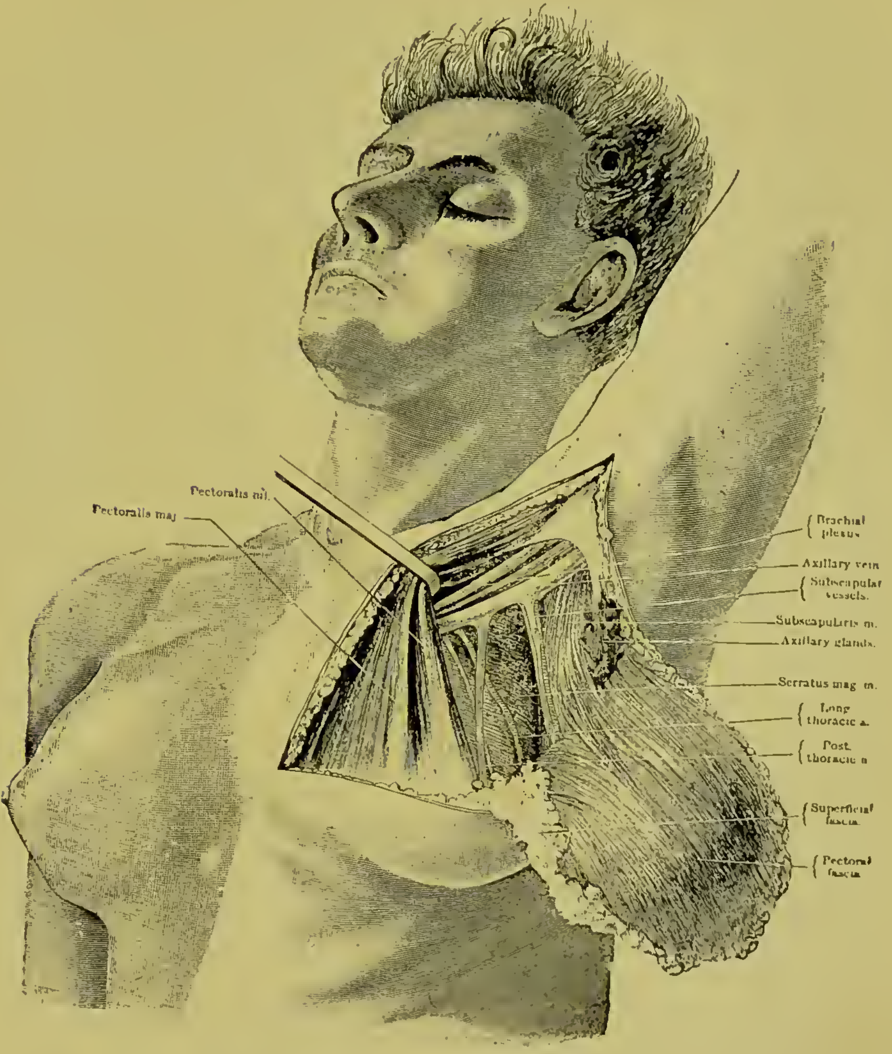


Fig. 78.

PLATE XXII.—CLEARING OUT AXILLA IN MAMMARY CANCER.



The operation above depicted is the one required in all cases of carcinoma of the breast. Contrary to the method above described the upper incision is first made and should extend outwards to the tendon of the biceps. After freeing the edges of the pectoral muscles the axillary vessels come into view and we get complete command of the only part from which serious hæmorrhage may be apprehended during the remaining steps of the procedure.

SUPRA-CONDYLOID OSTEOTOMY FOR GENU VALGUM.

Macewen's.—The limb having been made aseptic, bloodless, and laid on a sand pillow, enter a scalpel at a point where a line drawn transversely a finger's breadth above the superior tip of the external condyle meets a longitudinal one drawn half an inch in front of the abductor magnus tendon. Penetrate to the bone, and cut longitudinally upwards for one inch. Before withdrawing the scalpel, make it guide the osteotome to the bone. The osteotome, which was introduced longitudinally, is now turned transversely, and made to divide the bone, cutting at first from behind forwards and outwards, afterwards from above backwards and outwards. If the osteotome pains, change to a smaller one. When changing its direction, do not withdraw altogether from the groove made. Two-thirds, or in old subjects three-fourths, of the bone having been divided, dispense with the osteotome, cover wound with an aseptic sponge, and complete the division by grasping the limb at the seat of the wound with one hand, and using it as a fulcrum while the leg is bent inwards with the other, until it yields and comes into position. Remove Esmarch's band, and, if the other leg has to be operated on also, apply a temporary pad over wound. Finaly, apply an antiseptic dressing and put limb up in a Macewen's splint.

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